A PROGRAMMED SEQUENCE ON THE

# SLIDE RULE

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CHEMICAL EDUCATION MATERIAL STUDY

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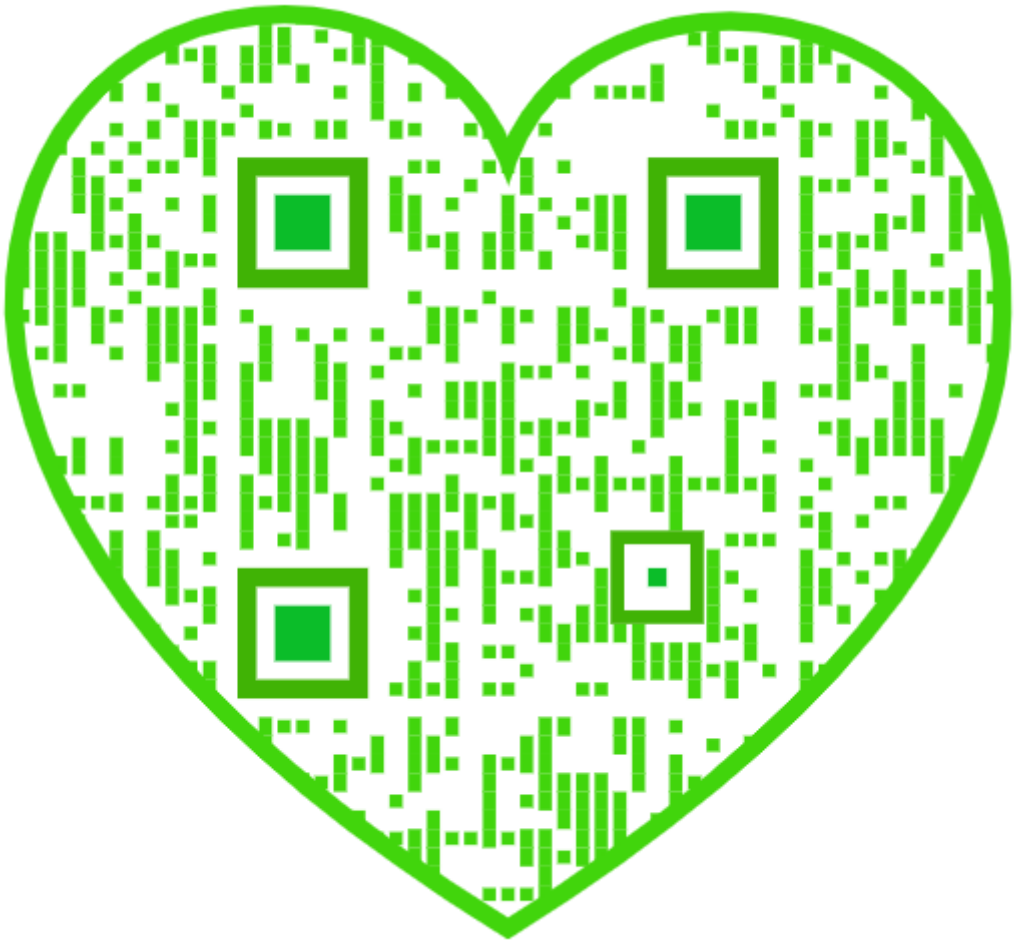

A Programmed Sequence on the

# SLIDE RULE

by

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The slide rule is an invaluable tool of the scientist and engineer. Its use in technical courses at the college level is mandatory. Its use in high school science and mathematics classes, while not an absolute requirement for these classes, will certainly help you through the computations which arise.

This booklet is designed to introduce you to the slide rule, to help you learn to read its scales, and to explain its use in multiplication, division, and the extraction of square roots. There are four parts

| | |
|---|---|
| Reading the Scales | Page 2 |
| Multiplication | 28 |
| Division | 42 |
| Extraction of Square Roots | 52 |

## How to Use This Booklet

This coverage of the slide rule is designed to be undertaken by you on a self-instructional basis. Using a small sheet of paper or cardboard as a mask, you are to conceal the answers which are listed in the right hand columns of the booklet until you have actually written down your own response on a separate sheet of paper. Do not mark this booklet itself so others will be able to use it again.

This trial material was developed by CHEM Study to facilitate computational work in the high school chemistry course.

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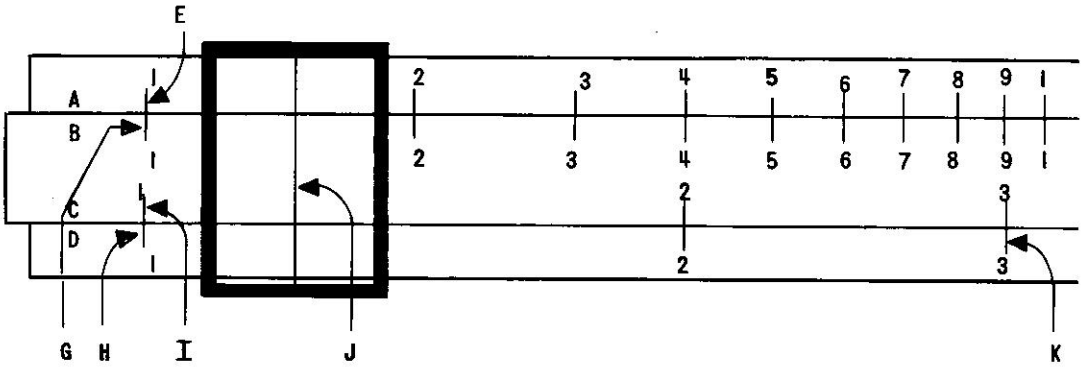



Panel 1 Diagram of a Slide Rule (showing only the primary scale divisions)

READING THE SCALES OF A SLIDE RULE

This first section is concerned only with developing skill in reading the slide rule scales preparatory to taking up the operations of multiplication, division, and extraction of roots. This presentation is purely operational. No background nor theory is included. The "how" is thoroughly covered; the "why" is not.

Look at Panel 1 at the top of the page.

This, as you might suspect, is a skeleton diagram of a

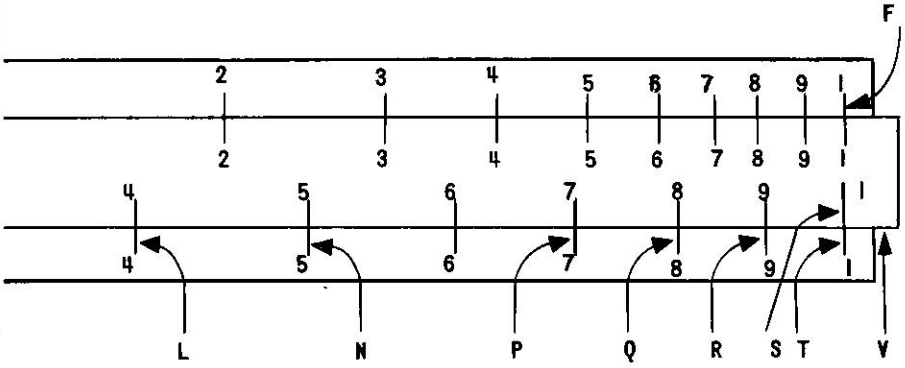
1 _____ _____. slide rule

You may want to compare this simple diagram with a slide rule of your own. Basically, all slide rules, from the simplest to the most expensive, are the same.

In the diagram of Panel 1, the middle, elongated part labeled "v" which sticks out the end is the part on your own rule which slides back and forth, and hence is called the "slide".

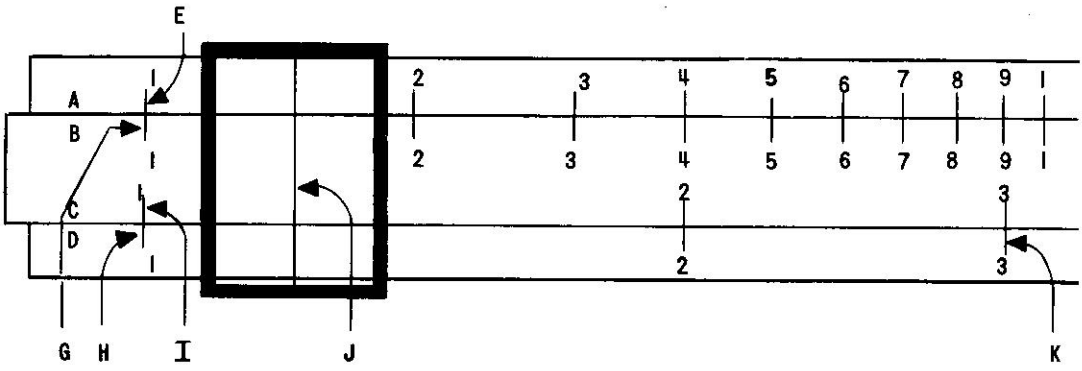
2 What two letters of the alphabet are shown on the slide at the left end? B and C

These letters B and C are used to label (or name) the various scales. The top scale on the slide is called the B-scale.



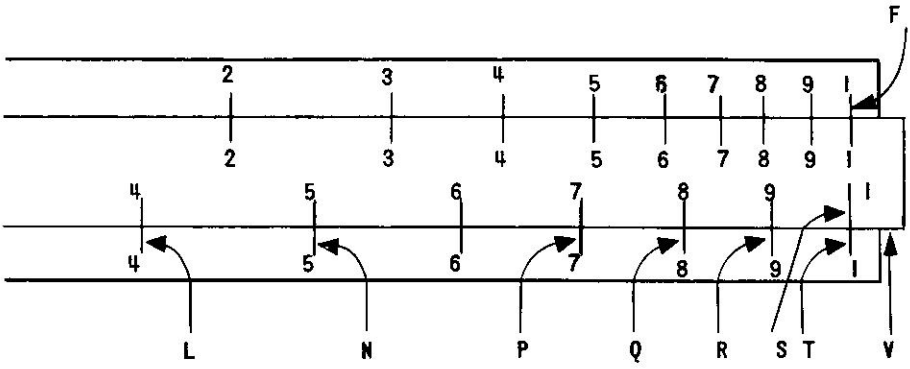

Panel 1 Diagram of a Slide Rule (showing only the primary scale divisions)

| | | |
|---|---|---|
| 3 | What is the other scale on the slide called?<br><br>All our questions are based on Panel 1, but you will want to compare your own slide rule, if you have one, with the diagrams, too. YOUR rule may have many more scales than are shown in Panel 1. We will ignore these "extra" scales in this program.<br><br>The part of the rule through which the slide moves on grooves is called the frame, or base, or body. We'll call it the frame. | C-scale |
| 4 | What two scales are shown on the frame in Panel 1?<br><br>Shown over on the left side of the rule between the numbers 1 and 2 on the A-scale is a glass-faced "runner" which can be moved along to any part of the rule. It is sometimes called a "cursor", or "indicator". In the glass face of the runner is a very thin "hairline", which runs perpendicular to the scales of the slide rule. | A-scale and D-scale |
| 5 | What letter in Panel 1 points to the hairline? | J |
| 6 | What number appears at the left edge of the A-scale and the D-scale? | 1 |
| 7 | What number appears at the left edge of the B-scale and the C-scale? | 1 |



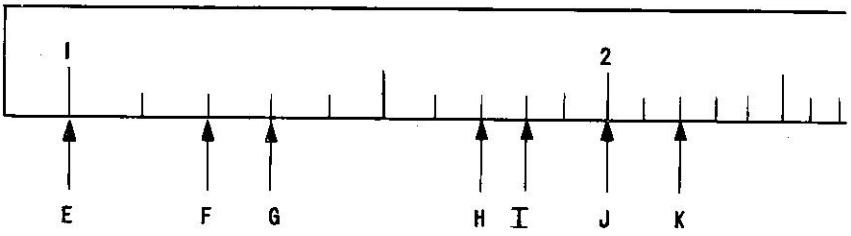

## Panel 1 Diagram of a Slide Rule (showing only the primary scale divisions)

| | | |
|---|---|---|
| 8 | Now look over to the right hand end of these scales. What number is found at the end of each of the four scales? | 1 |
| | These 1's mark two important parts of the rule, namely the indexes of the slide rule. The left index of the D-scale is shown in the panel by the letter "H". | |
| 9 | The right index of the D-scale is shown on the diagram by the letter ___. | T |
| 10 | The letter I points to the left___of the C-scale. | index |
| 11 | The letter S points to the ___index of the ____. | right C-scale |
| 12 | The letter E points to:_____. | left index of the A-scale |
| 13 | What letter points to the left index of the D-scale? | H |
| | Look at the C and D scales in the panel. | |
| 14 | Are the lengths of the spaces between the numbers equal or unequal? | unequal |
| 15 | Are the C and D scales uniform scales or non-uniform scales? | non-uniform |
| | These scales are non-uniform because they are logarithmic scales. In our diagram we have shown only the marks of the numbers, and not the detailed divisions you can see on your own slide rule. | |
| | On the C and D scales, for instance, the number 3 is located at the point marked with the letter K. | |




Panel 1 Diagram of a Slide Rule (showing only the primary scale divisions)

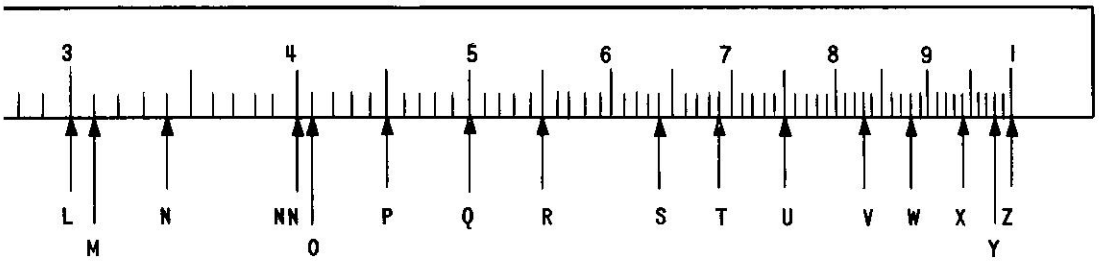
| | | |
|---|---|---|
| 16 | What number is located at the point marked by N? | 5 |
| 17 | What letter indicates a value of 9? | R |
| 18 | What number is indicated by the letter L? | 4 |
| 19 | What number is indicated by P? | 7 |
| 20 | What number is indicated by Q? | 8 |
| 21 | What number is indicated by R? | 9 |
| 22 | What number, then, is indicated by T? (Even though it's marked 1 on the scale!) | 10 |
| 23 | What number is indicated by K? | 3 |
| 24 | What number is indicated by L? | 4 |
| 25 | Where would you expect to find a number such as 3.5? | Half-way between 3 and 4 |
| 26 | Where would you expect to find 7.5 on the C-scale? | Half-way between 7 and 8 |
| 27 | The hairline on the runner is now set on a number between ___and____on the D-scale. | 1 and 2 |




## Panel 2 A Rough Diagram of the C-Scale (showing only the primary and secondary divisions)

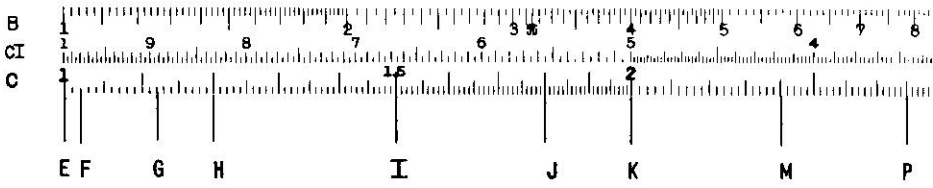
Now look at Panel 2.

| | | |
|---|---|---|
| 28 | This is a rough diagram of _____ . | the C-scale |
| 29 | This is the scale you would see if you slipped the ____ out of your own slide rule and looked at its bottom scale. | slide |
| 30 | The left index of the C-scale in Panel 2 is indicated by the letter ___. | E |
| 31 | The right index is indicated by the letter___. | Z |
| 32 | According to caption, Panel 2 does not show all the divisions of the C-scale, but only the so-called primary and _____ divisions. | secondary |
| | Locate the number 3 indicated by the letter L. | |
| 33 | The number 4 is indicated by the letters ___. | NN |
| 34 | How many spaces are there made by the secondary divisions between 3 and 4? | 10 |
| 35 | How many divisions (spaces) are there between 6 and 7? | 10 |
| | Remember, we're dealing with Panel 2 at the top of the page. | |
| 36 | How many divisions are there between 2 and 3? | 10 |
| 37 | From this investigation, or even more investigations, if you'd care to make them, we can see that the secondary divisions divide the primary divisions into___parts. | 10 |
| 38 | Since the 10 smaller secondary divisions divide each of the larger primary divisions into 10 parts, each secondary division is just one tenth, or 1/10, or ___of a major (primary) division. | 0.1 |
| | So, if we want to locate the number 3.1, we need to go just one secondary division beyond 3, as shown by the letter M. | |
| 39 | If we want to locate 4.1, we need to go just one secondary division beyond 4, as shown by the letter____. | 0 |
| | Between the numbers 1 and 2 (shown by letters E and J) the secondary divisions are so wide that on some slide rules each one can be numbered. The number 1.3 has the letter G. | |
| 40 | The number 1.8 has the letter____. | I |
| 41 | The number 2.2 has the letter____. | K |




Panel 2 A Rough Diagram of the C-Scale (showing only the primary and secondary divisions)

| | | |
|---|---|---|
| 42 | What number is indicated by the letter N? | 3.4 |
| 43 | What number is indicated by the letter U? | 7.5 |
| 44 | What letter indicates the number 8.3? | V |
| 45 | What number is indicated by F? | 1.2 |
| 46 | What number is indicated by X? | 9.4 |
| 47 | What number is indicated by Y? | 9.8 |
| 48 | What number is indicated by Z? | 10 (not 1!) |
| 49 | What letter indicates the number 1? | E |
| 50 | What letter indicates the right index of the C-scale? | Z |
| 51 | What letter indicates the number 1.7? | H |
| | Are you bored doing all these "number exercises"? Don't be!! If you're like most students starting to use a slide rule, you need this practice, even though it seems to be soo-o-o easy to do. Let's continue, then, | |
| 52 | with locating the letter which indicates the number 2.0. | J |
| 53 | What letter indicates the number 6.9? | T |
| 54 | What number does the letter S indicate? | 6.4 |
| 55 | What letter indicates the number 5? | Q |
| 56 | What letter indicates the number 5.0? | Q |
| 57 | What letter indicates the number 5.00? | Q |
| 58 | What letter indicates the number 6.4? | S |
| 59 | What letter indicates the number 6.40? | S |
| 60 | What letter indicates the number 1.20? | F |
| 61 | What letter indicates the number 3.10? | M |
| 62 | What number is indicated by the letter R? | 5.5 |
| 63 | What letter indicates the number 4.5000? | P |




## Panel 3 Diagram Showing Primary, Secondary and Tertiary Divisions

Now we'll be working with Panel 3.

64 How many scales are shown in Panel 3? — 3

We will completely ignore the B-scale and the CI-scale. All our readings will be on the C-scale.

65 In Panel 3, what letter indicates the left index of the C-scale? — E

You'll notice that our primary and secondary divisions of Panel 2 are on this C-scale as slightly longer lines. Now, however, additional lines (or divisions) have been filled-in so that we can now make closer readings of our numbers in Panel 3.

66 What number is indicated by the letter R? — 3, or 3.0, or 3.00

All of these answers apply since R is right on the line. So that we'll both usually get the same answers, let's give all the answers to two decimal places (three significant figures).

67 What number is indicated by the letter X? — 5.00

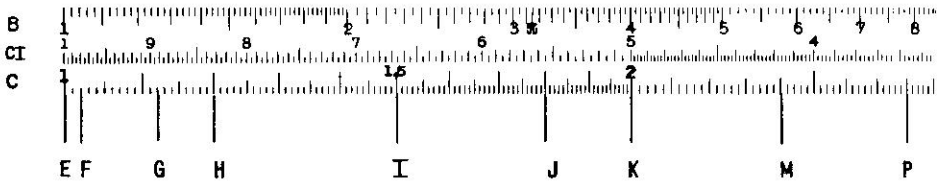
68 What number is indicated by the letter Z? — 6.50

69 What number is indicated by the letters GG? — 8.70

70 What number is indicated by the letter U? — 4.40

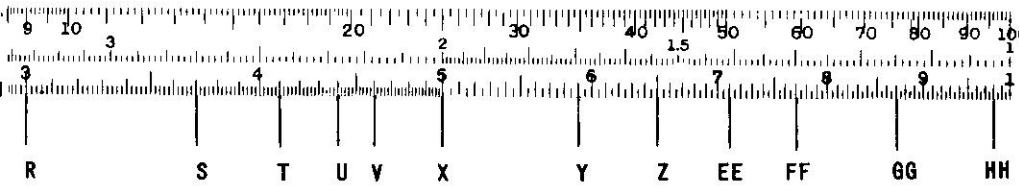
## Panel 3 Diagram Showing Primary, Secondary and Tertiary Divisions

| | | |
|---|---|---|
| 71 | What number is indicated by the letters HH? | 9.80 |
| | If you were correct on these last four items and feel you can read numbers of this type easily, go to Item No. 91. | |
| | If you missed any of these last four items, or if you feel you need more practice, go on to Item No. 72. | |
| 72 | What number is indicated by E? | 1.00 |
| 73 | What number is indicated by K? | 2.00 |
| | Notice that there are 10 secondary divisions between 1 and 2, each marked by a little longer line to set them apart. In Panel 3, letters H, I, and J point to three of these secondary divisions. | |
| | If there were 2 divisions, each would be equal to 1/2. If there were 5 divisions, each would be equal to 1/5. | |
| 74 | Since we have 10 divisions, each would be equal to_____? | 1/10 |
| 75 | Look at the letter I. It indicates the point which is___ secondary divisions beyond the number 1.00. | 5 |
| 76 | Since each division is 1/10 of the way from 1.00 to 2.00, five of these divisions would be 5/10, or 0.___ of the way from 1.00 to 2.00. | 0.5 (or, 0.50) |
| 77 | Therefore, the letter I indicates the number 1.___. | 1.50 |



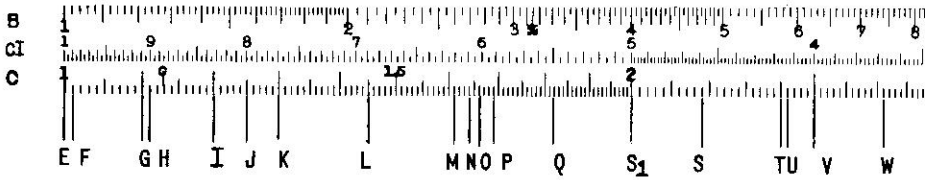

## Panel 3 Diagram Showing Primary, Secondary and Tertiary Divisions

| | | |
|---|---|---|
| 78 | What number is indicated by the letter J?<br>Notice that J is 8/10's of the way from 1.00 to ____. | 1.80<br>2.00 |
| 79 | The number indicated by K is _____, and the number indicated by R is _____. | 2.00<br>3.00 |
| 80 | You will notice that there are_____secondary divisions between these numbers. | 10 |
| 81 | Since there are ten divisions, each division will be equal to one-_____of the way from 2.00 to 3.00. | tenth<br>(1/10) |
| 82 | How many secondary divisions are there between the number 2.00 indicated by the letter K and the number indicated by the letter M. | There are<br>four. |
| 83 | Since there are 4 divisions, and each division is one-tenth, M must be _____-tenths beyond 2.00. | four-tenths |
| 84 | Thus the number indicated by the letter M is 2. ? .<br>Look at the number indicated by the letter S. | 2.40 |
| 85 | How many secondary divisions is it past the number 3.00? | 7 |
| 86 | Each of these divisions is one-tenth, so the number will be _____ tenths past 3.00. | seven-tenths |
| 87 | The reading at the letter S is _____. | 3.70 |



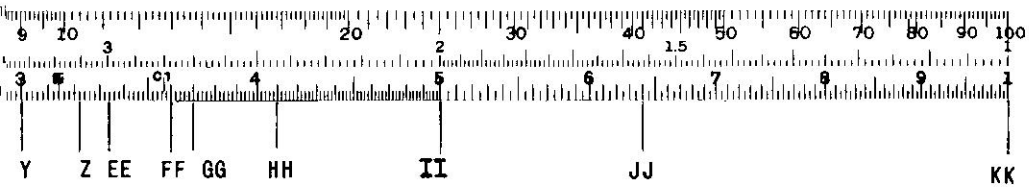

## Panel 3 Diagram Showing Primary, Secondary and Tertiary Divisions

| | | |
|---|---|---|
| | Locate the number indicated by the letter Y. | |
| 88 | How many secondary divisions is it from 5.00? | 9 |
| 89 | What number, then is indicated by the letter Y? | 5.90 |
| 90 | How many secondary divisions is the mark indicated by EE from 7.00? | one |
| 91 | What is the number indicated by the letters EE? | 7.10 |
| 92 | What number is indicated by the letter FF? | 7.70 |
| 93 | What letter is used to indicate the number 2.80? | P |
| 94 | What letter indicates 4.60? | V |
| 95 | What letter indicates 1.20 (on Panel 3)? | H |
| | If your answer was F, the reading would be 1.02.<br>If your answer was G, the reading would be 1.12.<br>If your answer was K, the reading will be 2.00. | |
| 96 | What letter indicates 2.40? | M |
| 97 | What letter indicates 4.10? | T |
| 98 | What letter indicates 1.50? | I |
| 99 | What letter indicates 7.10? | EE |




## Panel 4

| | | |
|---|---|---|
| 100 | Now shift your attention to Panel 4. How many scales are shown on this panel? | 3 |
| 101 | Once again we will ignore the two top scales and concentrate on the bottom, or _____-scale. | C-scale |
| | Thus far we've done pretty well at reading numbers to the first decimal place, for example, 4.50 and 9.30, and so on. Now we want to get on to reading that second decimal place. We've given our divisions on the C-scale two different names, thus far. The primary divisions and secondary divisions. | |
| 102 | For example, in Panel 4, the letters $S_1$, Y, and II, indicate the numbers 2.00, _____, and _____. | 3.00 and 5.00 |
| | These are primary divisions. Look at Panel 4. | |
| 103 | The primary divisions _____(always, sometimes) are marked with a number along the C-scale. | always |
| 104 | The primary divisions, which are always marked on the C-scale with the number they represent, give us the _____ (first, second, third) figure of our number. | first |
| | The secondary divisions are those we first met in Panel 2. For a moment turn back to Item 42 and look at Panel 2. | |
| 105 | How many secondary divisions are there between primary divisions which are labeled 2 and 3 in Panel 2? | 10 |
| 106 | How many secondary divisions are there between the primary divisions for 7 and 8 in Panel 2. | 10 |
| 107 | How many secondary divisions are there between any two successive primary divisions in Panel 2? | 10 |
| 108 | Going back to Panel 4 now, the letters T, HH, and JJ indicate the secondary divisions which stand for the numbers 2.40, ____, and _____. | 4.10 and 6.40 |
| 109 | These secondary divisions give us the _____(first, second, third) figure of our number. | second |
| 110 | Are the secondary divisions always marked with a number? | No |
| | (The secondary divisions are un-marked except between 1 and 2 on some slide rulers. Maybe your slide rule is one which has them marked between 1 and 2.) | |

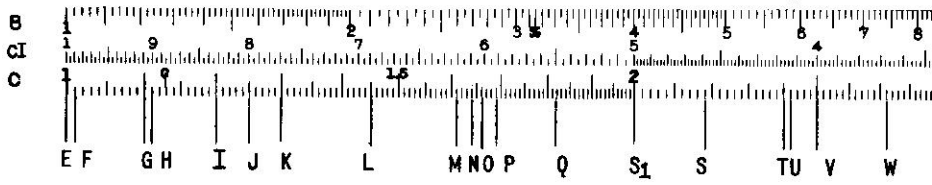



## Panel 4

Now we are ready for the divisions which appear between the various secondary divisions. These are called the tertiary divisions. If we learn this term it will make it easy for us to refer to these "smallest" divisions on the C-scale. "Tertiary" is pronounced ter-she-airy, with the accent on the first syllable.

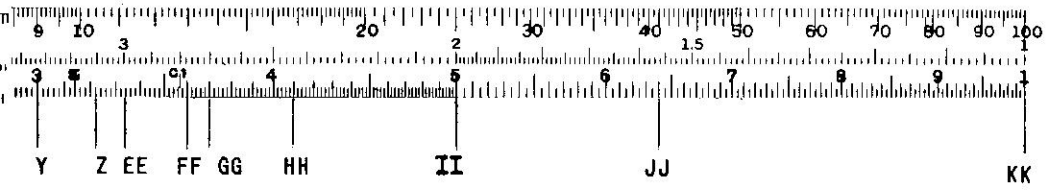
| Name of the division | Figure represented in Number |
|---|---|
| Primary | First |
| Secondary | Second |
| Tertiary | ? |

| | | |
|---|---|---|
| 111 | What should be in the blank space in this chart? | third |
| 112 | The tertiary divisions, then, are used to give us the _____ figure of our number. | third |
| 113 | What numbers are indicated by the letters I and K in Panel 4. | 1.20 and 1.30 |
| 114 | How many tertiary divisions are there between these two numbers? | 10 |
| 115 | Since there are 10 divisions, each tertiary division has a value of _____-tenth of a secondary division. | one-tenth |
| 116 | Now locate J and note the mark it points to. I is 1.20. How many of the tertiary divisions are there between I and J? | five |
| | In going from 1.20 to 1.30 there are ten divisions, but J is only five divisions beyond 1.20, or just half-way. So J indicates the number 1.25 on our C-scale. | |
| 117 | Select the number which is indicated by the letter L: a)1.40, b) 1.45, c) 1.50, d) 1.55. | b) 1.45 |
| | Now look at the number indicated by the letter M. | |
| 118 | Is it 1.60? | No |
| | M is one small division beyond 1.60. | |
| 119 | If it is one small division beyond 1.60, is M a) 1.61, b) 1.70, c) 1.50 or d) 1.66? | a)1.61 |
| 121 | If the number indicated by N is four small divisions from 1.60, what number is it? | 1.64 |




## Panel 4

| | | |
|---|---|---|
| 122 | Is the number indicated by the letter P equal to 1.70? | No |
| 123 | How many divisions are there between the number indicated by P and 1.60? | 9 |
| 124 | The number indicated by P, then, is 1.6? | 1.69 |
| 125 | What reading would you assign to the letter O? | 1.66 |
| 126 | What letter indicates the number 1.82? | Q |
| 127 | What letter indicates the number 1.01? | F |
| 128 | What letter indicates the number 1.10? | G |
| 129 | What letter indicates the number 1.00? | E |
| 130 | What letter indicates the right index of the C-scale | KK |
| 131 | What number is indicated by the letter H? | 1.11 |
| 132 | What number is indicated by K? | 1.30 |
| 133 | What number is indicated by the letter F? | 1.01 |
| 134 | What letter indicates the left index of the C-scale? | E |
| 135 | What number is indicated by T? | 2.40 |
| 136 | What number is indicated by V? | 2.50 |
| 137 | In between these last two numbers, T and V, how many tertiary divisions do you count? | 5 |
| 138 | In going from 2.40 to 2.50 in five divisions, each division must have a value equal to a) 1, b) 2, c) 3, d) 4? | b) 2 |
| | This means that each division has a value of 2. | |
| | Since V has the value 2.50 the number indicated by the next small division would have the value of 2.52. | |
| 139 | The number indicated by the letter U, which is just one small division above 2.40, has the value 2.4?. | 2.42 |
| 140 | What is the number indicated by the letter W? | 2.72 |

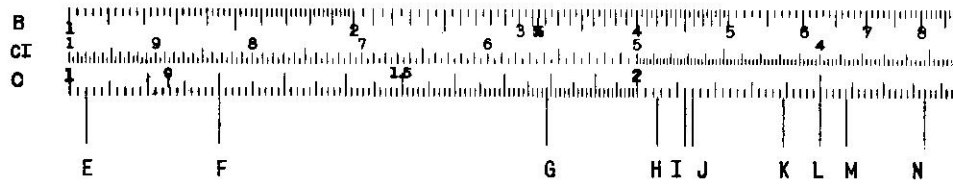



## Panel 4

| | | |
|---|---|---|
| 141 | Locate the numbers 3.60 and 3.70 in Panel 4. These are indicated by the letters _____ and _____. | FF and GG |
| 142 | How many tertiary divisions are there between these two numbers? | 5 |
| 143 | This means that, as before, each division will have a value of ____ (1, 2, 3, 4). | 2 |
| 144 | If each division has a value of 2, what is the number indicated by the next small division above (to the right of) 3.70? | 3.72 |
| 145 | What number is indicated by the letter Z? | 3.22 |
| | Since, in this part of the C-scale (between 2.00 and 5.00), each of the tertiary divisions has a value of 2, we can set-up the following chart: | |

| No. of Divisions | Value |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | ____ |
| 4 | ____ |

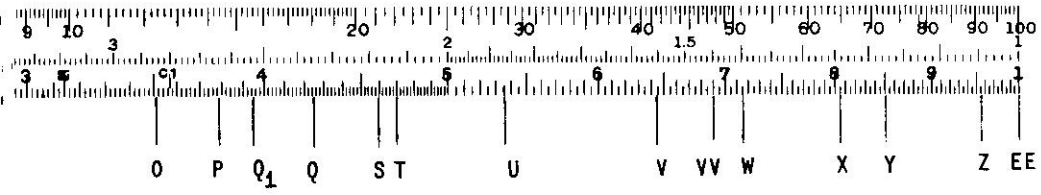
| | | |
|---|---|---|
| 146 | Fill-in the two blank spaces. | 6, 8 |
| | Locate the point indicated by the letter S on the C-scale. | |
| | This number lies between 2.10 and 2.20. | |
| 147 | How many tertiary divisions is it from 2.10? | 4 |
| 148 | In this part of the C-scale, each of the tertiary divisions has a value of ____. | 2 |
| 149 | Since we have 4 divisions, with a value of 2 for each division, our total value for the 4 divisions is 4 x 2, or ____. | 8 |
| 150 | So, our number indicated by S is 2.1?. | 2.18 |
| 151 | What number is indicated by the letters EE? | 3.34 |
| | If you did not get this answer correct, you may want to go back to Item No. 137 and follow this development through again. | |




# Panel 5

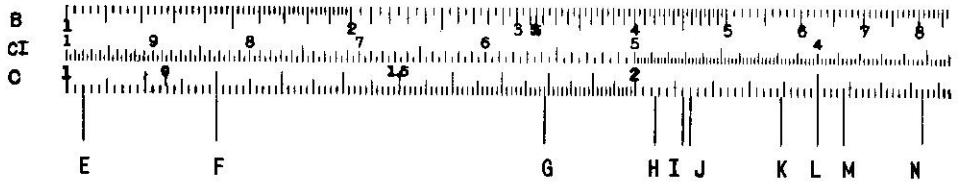
Now refer to Panel 5.

| | | |
|---|---|---|
| 152 | This Panel 5 shows the same three scales that were shown on the previous panel, namely the _____, _____, and _____ scales. | B, CI, and C-scales |
| 153 | On Panel 5, what values are indicated by the letters I and J? | I: 2.12<br>J: 2.14 |
| 154 | Looking at these two numbers (2.12 and 2.14) where should the number 2.13 lie in relation to them? | half-way between |
| 155 | Looking at Panel 5, is there a division mark on the scale between letters I and J? | No |
| 156 | Even though there is no mark between 2.12 and 2.14, it is easy to locate 2.13 because 2.13 is just _____ (how far) between 2.12 and 2.14. | half-way |
| 157 | Let's take the number 3.25. This number is located just half-way between 3.24 and _____. | 3.26 |
| 158 | Are the numbers 3.24 and 3.26 marked by divisions on the C-scale? | Yes |
| 159 | Is the number 3.25 marked by a division on the C-scale between 3.24 and 3.26? | No |
| 160 | Even though it is not marked, we know that the number 3.25 is located just _____between 3.24 and 3.26. | half-way |
| 161 | Look at the number indicated by the letter K. Is it on one of the marked divisions? | No |
| 162 | What is the number of the next division to the right of the letter K? | 2.40 |



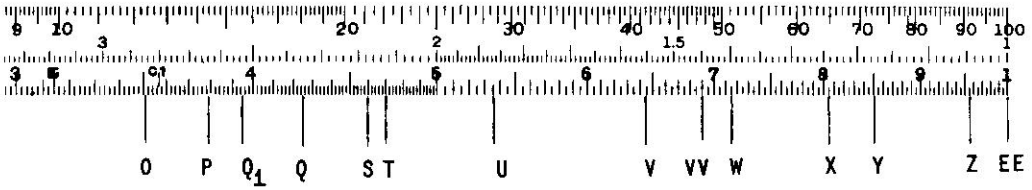

Panel 5

| | | |
|---|---|---|
| 163 | What is the number of the next division to the left of the letter K? | 2.38 |
| 164 | If the letter K is just half-way between the divisions for 2.38 and 2.40, what number does it indicate? | 2.39 |
| 165 | What number does the letter P indicate? | 3.79 |
| 166 | What number does the letter N indicate? | 2.84 |
| 167 | What number is indicated by the letter O? | 3.51 |
| 168 | You'll remember that we have three kinds of markings on our C-scale, primary, secondary, and tertiary. In the range of numbers between 1.00 and 2.00 on the C-scale of Panel 5, there are _____(how many) tertiary markings between each secondary mark. | 10 |
| 169 | Between 2.00 and 5.00, there are ____(how many) tertiary markings between each secondary mark? | 5 |
| 170 | Now we are down to the tertiary markings between 5.00 and the end of the scale at 10.00. This last number is indicated by the letter _____ in Panel 5. | EE |
| 171 | The right index of the C-scale is indicated by the letter _____. | EE |
| 172 | Locate the number 4.60. It is indicated by the letter ___. | S |
| 173 | Locate the number 4.70. It is indicated by the letter _____. | T |
| 174 | Now we have the numbers 4.60 and 4.70. The number 4.65 would be located just _____-way between these two numbers. | half |



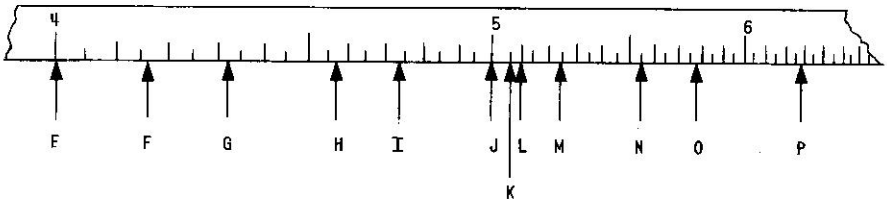

## Panel 5

| | | |
|---|---|---|
| 175 | Locate the point on the C-scale which is half-way between 4.60 and 4.70. This is the number 4.65. Is it marked by a division? | No |
| 176 | The number 4.25 lies just half-way between 4.20 and _____. | 4.30 |
| 177 | Locate 4.20 and 4.30 on the C-scale. Half-way between these two numbers you will locate 4.25, which is indicated by the letter _____. | Q |
| | Does 4.25 lie exactly on a line division? | No |
| 178 | The number 5.35 lies half-way between the numbers 5.30 and _____. | 5.40 |
| 179 | On the C-scale, 5.35 is indicated by the letter _____. | U |
| | Does it lie exactly on a line division? | Yes |
| 180 | The number 6.45 is indicated by the letter V. It lies just half-way between _____ and _____. | 6.40 and 6.50 |
| 181 | What number is indicated by the letter W? | 7.15 |
| 182 | What number is indicated by the letter X? | 8.05 |
| 183 | What number is indicated by the letter Y? | 8.50 |
| 184 | What number is indicated by the letter Z? | 9.55 |
| 185 | What letter indicates the number 2.58? | M |
| 186 | What letter indicates the number 1.02? | E |
| | If you selected F for this last one you were at the number 1.20. | |




Panel 5

| | | |
|---|---|---|
| | If you missed this answer, and are confused by it, you may want to try Item No. 95 and Items No. 127-133 again before coming back to Item No. 187. | |
| 187 | Is the number 2.22 marked by a division? | Yes |
| 188 | Is the number 3.33 marked by a division? | No |
| 189 | Is the number 3.95 marked by a division? | No |
| 190 | What letter is closest to indicating the number 3.95? | $Q_1$ |
| 191 | Is the number 5.95 marked by a division? | Yes |
| 192 | The next division to the right of 5.95 marks the number _____. | 6.00 |
| 193 | The next division to the right of 6.00 marks the number _____. | 6.05 |
| 194 | What number is indicated by the letter W? | 7.15 |
| 195 | What number is indicated by the letter VV? | 6.90 |
| 196 | What number is indicated by the letter Q? | 1.79 |
| 197 | The number 2.05 is indicated by the letter _____. If your answer was L, you selected the number 2.50! This is an easy error to make, so you must be alert to avoid it. | H |
| 198 | Is the number 3.45 indicated by a division mark? | No |
| 199 | Is the number 6.15 indicated by a division mark? | Yes |




Panel 6 A Section of the C-Scale Enlarged Three Times for Instructional Purposes

Now look at Panel 6.

200 This panel shows a section of the _____-scale of a slide rule which has been enlarged _____ times.

C-scale
three

We've enlarged this section of the scale in Panel 6 to make it easier to illustrate some of the points of reading the tertiary scale in this part of the slide rule. If you have a slide rule of your own you can compare its C-scale with this enlargement and see that they are essentially the same.

201 In Panel 6, the letter J indicates the number _____, which is marked by a primary division.

5.00

202 The letter L indicates the number _____ which is marked by a secondary division.

5.10

203 In between this primary division of J and the secondary division of L there is another division, a tertiary division which is marked by the letter _____.

K

204 This letter K indicates the number _____ which is just half-way between 5.00 and 5.10.

5.05

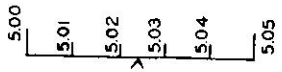
205 Since the number 5.02 falls between 5.00 and 5.05, it (5.02) should be located somewhere between the letters J and _____.

K

206 In considering the location of the number 5.02 between 5.00 and 5.05:

Is it a) exactly half-way between
b) a little less than half-way between
c) a little more than half-way between

b)




207 From this diagram we can see that 5.02 is as far to the left of the center point as 5.03 is to the right of the center point. As a matter of fact, the center point is just half-way between 5.02 and _____.

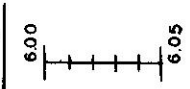
5.03

208 The number which is exactly half way between _____ and 5.03 is 5.025.

5.02

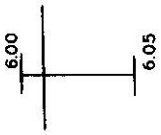
209 On a separate sheet of paper draw a line which is about an inch or so long. Mark a division at each end of this line. Label the left hand division 6.00. Label the right hand division 6.05. (When you have done this check the answer.)

210 Now divide your line into five equal spaces by putting four marks in between 6.00 and 6.05. Don't use a ruler to do this, just judge it "by eye."




211 The left hand division is labeled 6.00 and the right hand one is labeled 6.05. Number each of the in-between divisions with its proper number between 6.00 and 6.05.

212 Look at the line segment below and estimate the number which is indicated by the long, perpendicular line?

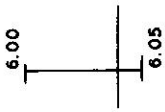



Which number does the long, vertical line indicate?

a) 6.00
b) 6.10
c) 6.01
d) 6.20
e) 6.02

c) 6.01

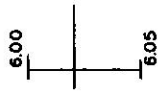
213 On this same segment, which number does the long, vertical line indicate?




a) 6.02
b) 6.03
c) 6.04
d) 6.30

c) 6.04

214 On the segment which is shown, which number does the long, vertical line indicate?

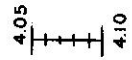



a) 6.02
b) 6.03
c) 6.04
d) 6.20

a) 6.02

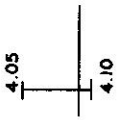
215 Now draw a line which is only about half an inch long, mark a division at each end, label the left division 4.05 and the right one 4.10.

216 Once again, divide this line into five equal spaces by inserting four division marks between 4.05 and 4.10.




217 Label each of the divisions with its proper number.

218



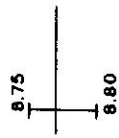

What number does the long, vertical line indicate?

a) 4.05
b) 4.01
c) 4.90
d) 4.10
e) 4.09

e) 4.09

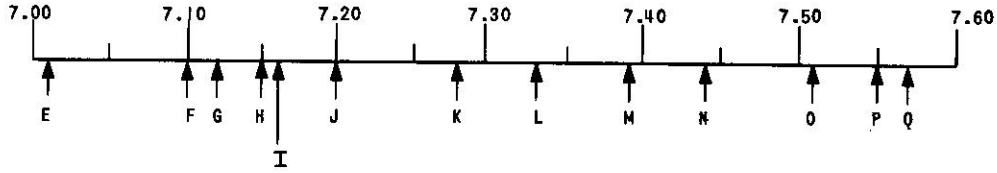
219 What number does the long, vertical line indicate?

a) 8.76
b) 8.77
c) 8.78
d) 8.79




b) 8.77

You might have selected a 8.76 but notice that the vertical line is closer to the center than it is to the left mark.




Panel 7

Look at Panel 7.

220 The letter F indicates the number _____. 7.10

221 The letter J indicates the number _____. 7.20

222 The letter H indicates the number _____. 7.15

223 Remembering how you judged the distances on the line segments on the last couple of pages, what letter would you select as indicating 7.16? I

224 What letter indicates the number 7.12? G

225 The letter O indicates the number:
a) 7.50
b) 7.51
c) 7.52
d) 7.53
e) 7.54
f) 7.55
b) 7.51

226 The letter N indicates the number:
a) 7.40
b) 7.30
c) 7.43
d) 7.34
e) 7.50
f) 7.44
f) 7.44

227 What number is indicated by the letter P? 7.55

228 What number is indicated by the letter G? 7.12

229 What number is indicated by the letter I? 7.16

230 What number on Panel 7 is indicated by the letter L? 7.33

231 The letter K indicates the number _____. 7.28

232 What number does the letter Q indicate? 7.57

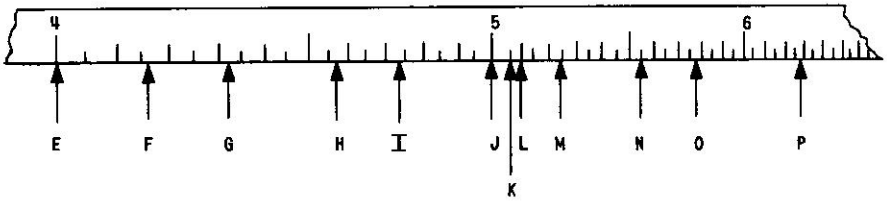
233 What is the number indicated by the letter M? 7.39

234 The number _____ is indicated by the letter E. 7.01

235 The number indicated by the letter F is _____. 7.10

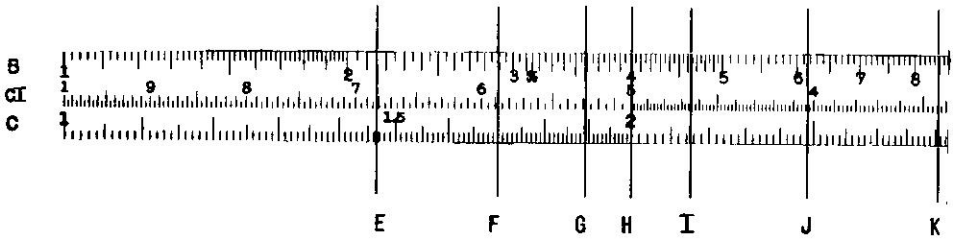
This Panel 7 is a very large scale compared to Panel 6.

Now let's look again at Panel 6 at the top of the next page.




Panel 6 A Section of the C-Scale Enlarged Three Times for Instructional Purposes

| | | |
|---|---|---|
| 236 | Using this same method, what is the number indicated by the letter E in Panel 6? | 4.00 |
| 237 | In Panel 6, what number is indicated by the letter L? | 5.10 |
| 238 | Using our method of dividing the space into 5 equal parts as we did before, what is the number indicated by the letter F (on Panel 6)? | 4.16 |
| 239 | What number is indicated by the letter N? | 5.55 |
| 240 | The letter I indicates the number _____. | 4.73 |
| | Often the third figure in a number is a matter of individual interpretation--what looks like 4.73 to one person is closer to 4.74 for another. If you are only one number away from the answer given in this program don't be concerned that you are wrong. | |
| 241 | The number _____ is indicated by the letter G. | 4.32 |
| 242 | The letter H indicates the number _____. | 4.57 |
| 243 | What number is indicated by the letter O? | 5.78 |
| 244 | The number _____ is indicated by the letter P. | 6.29 |
| 245 | The number indicated by the letter M is_____. | 5.24 |



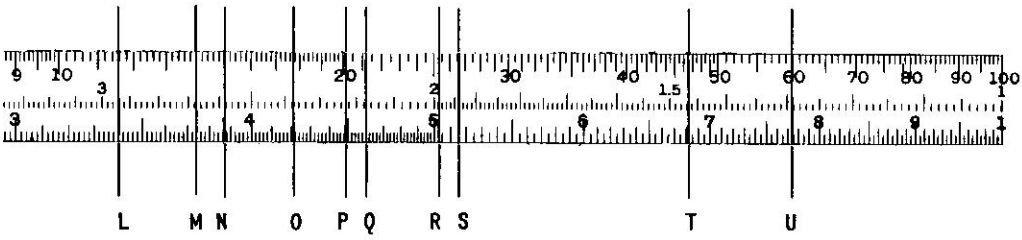

# Panel 8

The readings we made in panel 6 were from an enlarged version of the C-Scale.

In Panel 8 we will use an actual C-scale in practicing our readings as a wind-up of our program on reading the scales of C and D-scales of a slide rule.

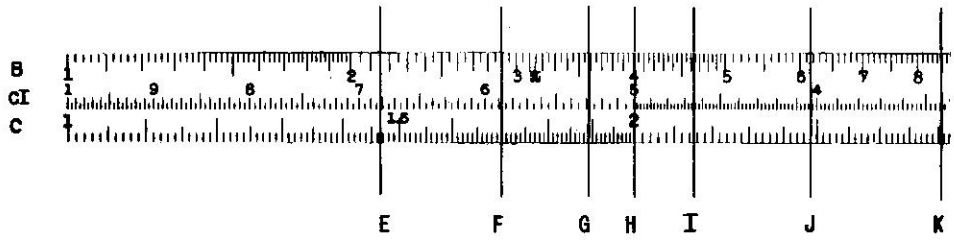
On Panel 8 a number of "hairlines" have been drawn to give you some practice on reading settings which have been made on an actual C-scale. In these readings you ought to get the first two figures of the numbers correct, but the third figure is sometimes subject to different interpretations by different people. In an case you ought to agree with the given answer within one number of the third figure.

| | | |
|---|---|---|
| 246 | What number does hairline H indicate on the C-scale of Panel 8? | 2.00 |
| 247 | What is the number under hairline L? | 3.40 |
| 248 | What is the number under hairline Q? | 4.60 |
| 249 | What is the number under hairline S? | 5.15 |
| 250 | What is the number under hairline J? | 2.48 |
| 251 | What is the number under hairline M? | 3.74 |
| 252 | What is the number under hairline F? | 1.70 |
| 253 | What is the number under hairline G? | 1.89 |
| 254 | What number is under I?<br>Notice that the hairline I is half-way between the division marks for 2.14 and 2.16. | 2.15 |
| 255 | What number is under K? | 2.91 |
| 256 | What number is under hairline N? | 3.87 |
| 257 | The number under hairline O is _____. | 4.21 |




## Panel 8

| | | |
|---|---|---|
| 258 | What number is under hairline P? | 4.49 |
| 259 | What number is under hairline R? | 5.03 |
| | You might have read R as 5.04, but <u>not</u> as 5.05 or 5.02. | |
| 260 | What number is indicated by hairline T? | 6.81 |
| | You might have read T as 6.82, but <u>not</u> as 6.80 or 6.83. | |
| 261 | What is the number of hairline U? | 7.74 |
| | You might have read it as 7.73, but NOT as 7.75. | |
| | On your own slide rule you will find that the "hairline" in the glass face of the runner <u>really</u> is a <u>hairline</u>, and not nearly as thick as the line drawn on Panel 8. This thin hairline makes it easier to read the numbers on the scales. | |
| | The reading of numbers on the scales of a slide rule is the hardest part of using a slide rule--that is why we have spent so much time in getting this foundation prior to actually using the slide rule. | |
| | The numbers we have been reading from the slide rule have had a figure followed by a decimal point, i.e., 3.48 or 6.94 and so forth. To be of any use, the slide rule must be able to use <u>any</u> numbers. This program has used this form for numbers (5.67), because it is easier to learn to read the scales with this type of number. | |
| 262 | Thus far, using numbers like 3.45, we have used numbers with only _____ (how many) figures in them. | three |
| 263 | From our last exercise in locating numbers on Panel 8 we can appreciate that it is difficult to "read" the slide rule any closer than ___ figures. | 3 |
| 264 | Thus any number we want to set on the slide rule will have to be changed to a number with only ____ figures in it. | 3 |




## Panel 8

265 There is an exception here, since on the C-scale the divisions between 1 and 3 are wide enough so that you can set, sometimes, four figures. To show this, go back to Panel 8 for a moment, and note the reading of hairline E. What number, using four figures does it indicate? — 1.465

If you find you can set four figures, then do so, but we're going to assume that we can only set 3 figures in order to keep this presentation to you simple. Since we will set only three figures,

266 any number we get must then be changed to ____ figures. — 3

267 If we change the number 456 to a form that we are used to setting on our C-scale, we would call it 4.56.

How would we change 234 in order to have it in "our" form? — 2.34

This means that, for the time being, we are ignoring the true position of the decimal point--but don't worry about it now.

268 The number 13,600 would become 1.36 in "our" format. How would we change the number 65,700? — 6.57

269 Change 116,000 to our format. — 1.16

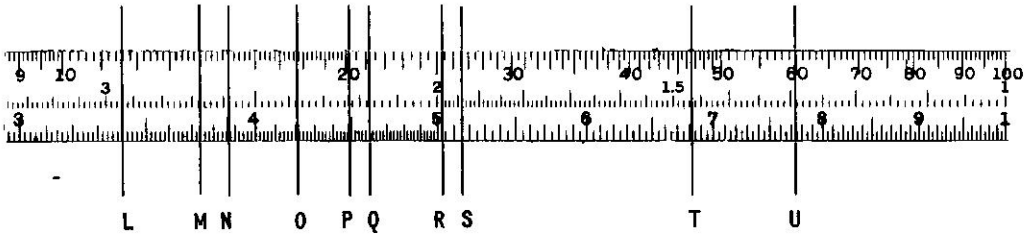
270 Change 0.00987 to our format. — 9.87

271 All we are doing here is to rewrite the number so that it lies between 1 and ____ and is in a form that we are used to locating on the C-scale. — 10

If a number has more than three figures in it, we merely "round it off" to three figures, and put it between 1 and 10. For example, 2342 becomes 2.34.

272 4532 would become _____. — 4.53

273 0.009874 would become _____. — 9.87




Panel 8

If the fourth number which is dropped is a 5 or larger, then we raise the value of the third number by 1. For instance, 5.679 would become 5.68.

274 Or, 4.568 would become _____. 4.57

The number 8,765 would be changed to 8.77.

275 The number 4,637 would be changed to _____. 4.64

276 The number 78,995 would be changed to _____. 7.90

277 The number 0.0003576 would become _____. 3.58

Using this system we can set any number on our C-scale.

278 Using Panel 8, what letter would indicate the number 29,100? K

279 What letter indicates 0.002906? K

280 What letter indicates 2,913,480? K

281 Where on Panel 8 would you find the following different values located?

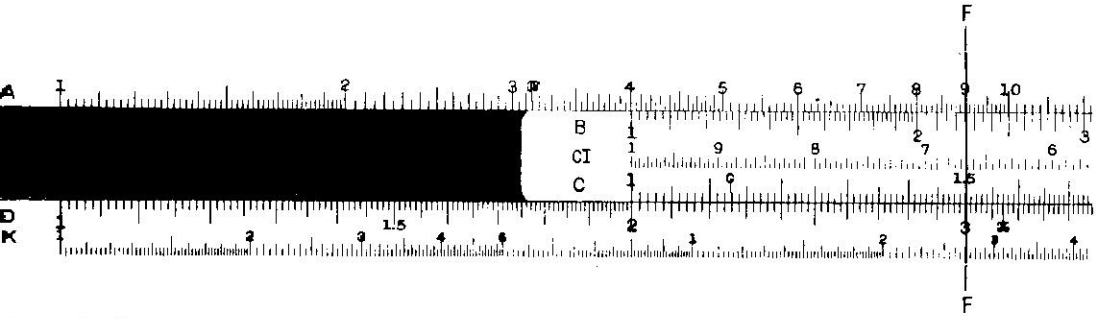
a) 0.00515 b) 5.15 c) 51,500,000 d) 515 and e) 51.5 all under hairline S

282 Thus, we can say that the location on the slide rule scale _____ (does, does not) depend on the location of the decimal point, but only on the figures which make up the number. does not

This means that our changing the numbers to conform to "our" format of a number followed by a decimal point (i.e., 5.67) does not affect our operation of the slide rule.

We have spent a long time on just locating numbers on our C-scale. Now we are ready to take up multiplication, using the C and D scales

The next section of this program covers multiplication with a slide rule.




Panel 9

## SLIDE RULE MULTIPLICATION

Now that we are able to read the scales of the slide rule to three significant figures, we shall find that the operations of multiplication and division on the slide rule are quite simple and much less tedious than our work with the scales.

In most of these exercises it would be well to work along with each item with your own slide rule. If it is a 10-inch slide rule, you will be able to do all the settings and readings asked for by using the C-scale and the D-scale of your own rule regardless of how few or how many other scales it may have.

Our first problem will be a simple but fundamental one:

$$2 \times 3 = ?$$

On your own slide rule make the setting which is shown in Panel 9 (If you don't have a slide rule, then just refer to the panel itself.).

1 In this setting, the left index of the C-scale is placed directly over the number_____on the _____-scale. — 2, D-scale

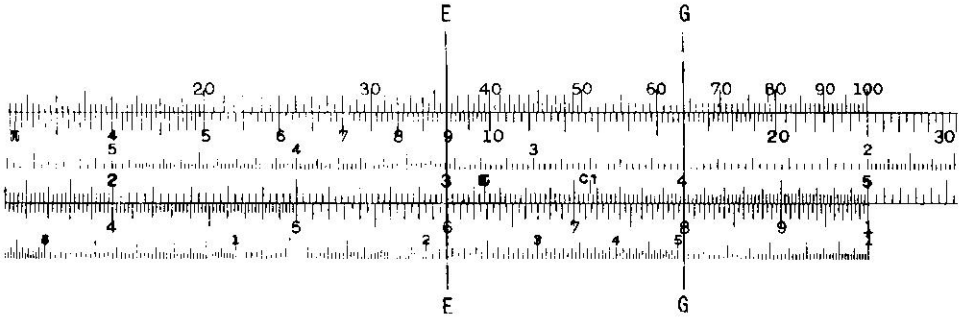
2 Now move your hairline along the C-scale until it is over the number 3. Check the answer to be sure your setting is correct. — See hairline E.

If your hairline is the same as the letter F, you made your setting of 3 on the D-scale instead of the C-scale.

3 Directly under your hairline E you will read on the D-scale the answer, _____. — 6 (or, 6.00)

We have made the setting for $2 \times 3 = 6$.

4 To solve this problem, we moved the _____ _____ of the ____-scale until it was directly over the number 2.00. — left index C-scale




## Panel 9

| | | |
|---|---|---|
| 5 | In solving 2 x 3 = 6, we set the left index of the C-scale directly over the number 2.00 on the ___-scale. | D-scale |
| 6 | In solving 2 x 3 = 6, we set the left index of the C-scale directly over the number 2.00 on the D-scale. Then we moved the hairline along the ___-scale until it was directly over the number _____. | C-scale 3.00 |

This setting which you now have on your slide rule, 2 x 3 = 6, is a kind-of-a "base" position. If you should be a little hazy in the future as to how to make a multiplication setting, this position will help you remember the proper setting for multiplying with a slide rule.

Now "break" your present setting of your slide rule by again lining up your C-scale and D-scale. (This will give you practice in making a "fresh" setting for each problem.)

| | | |
|---|---|---|
| 8 | Set your slide rule, including the hairline, to solve the following problem:<br>2 x 4 = ?<br>Now check the answer to be sure your setting is correct. | See hairline G. |
| 9 | Directly under your hairline (which should be the same as G) you can read the number of the answer as ___on the___-scale. | 8.00 D-scale |

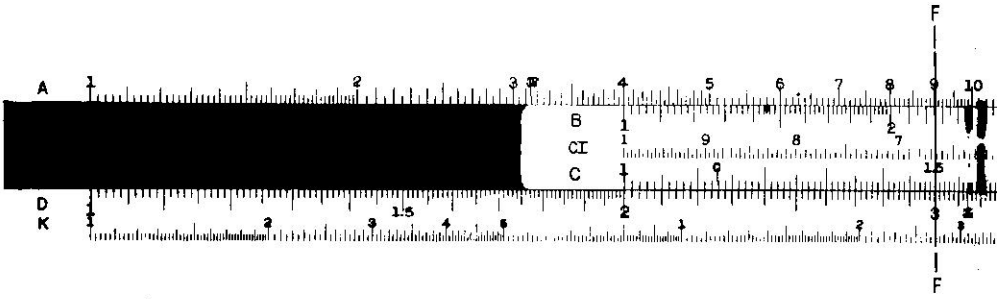
If your answer and your setting of this last box were correct and you feel you need no further drill on this type of setting, go to the next box.

If you'd like to go over this type of setting a little more, complete this box.

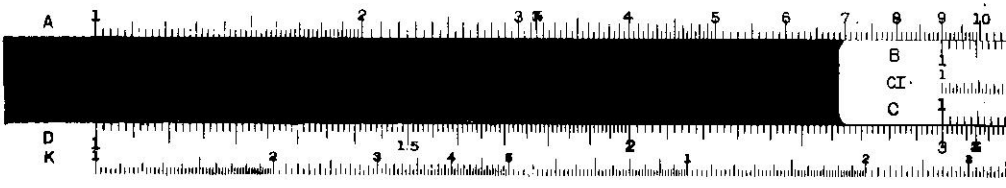
| | | |
|---|---|---|
| | For the problem 2 x 4 = 8, your slide rule ought to have the setting shown in Panel 9, with the hairline in position G. | |
| 10 | To get this setting you must first move the slide of your rule until the ___ _____ of the C-scale is directly over the number 2.00 on the ___-scale. | left index D-Scale |
| 11 | After setting the left index of the C-scale over 2.00 on the D-scale, you move the ____along the ____-scale to the number 4.00. | hairline C-scale |
| 12 | With the left index of the C-scale over 2.00 on the D-scale, and the hairline over 4.00 on the C-scale, the number of the answer, 8.00, is read under the hairline on the___-scale. | D-scale |

| | | |
|---|---|---|
| | Again, "break" your present setting of your slide rule, and line up your scales. | |
| 13 | Now make the setting for the problem 3 x 3 = ? | See Panel 10, using hairline I on pg. 33. |
| | After your setting has been carefully made on your own slide rule, check it with the answer. | |
| 14 | Under the hairline you read the number of the answer as being ____. | 9.00 |
| | If your setting was correct, and you read the correct answer from your slide rule (not just because you know that 3 times 3 is 9!) and you feel you know this type of setting fairly well, you may want to go to the next box. | |
| | If your setting was incorrect, at first, or you want a little more coverage of this important setting for multiplication, continue along in this box. | |
| | You ought to have the setting shown in Panel 10 with hairline I. This problem is 3 x 3 = ?. To get this setting, you move | |
| 15 | the slide of your rule until the ___ ____ of the ___-scale is directly over the number ___ on the ___-scale. | left index<br>C-scale<br>3.00<br>D-scale |
| | In the setting 3 x 3 = ?, we move the left index of the C-scale until it is over the number 3.00 on the D-scale. | |
| 16 | Then we move the _____ along the ___-scale until it is directly over our second factor which is also 3.00 on the ___-scale. | hairline<br>C-scale<br>C-scale |
| | For the problem 3 x 3 = ? we have set our left index over one factor on the D-scale and our hairline over the other factor on the C-scale. Now we read the number of the answer | |
| 17 | under the ___on the ___-scale. | hairline<br>D-scale |
| | Set your slide rule to solve the following problem: 2 x 1.5 = ? | |
| 18 | After making your setting and writing down the answer you read off your rule, check the answer. | See Panel 9, hairline F. |
| 19 | The number of the answer which is read under hairline F on Panel 9 is _____. | 3.00 |
| 20 | The answer is read from which scale? | D-scale |
| | If your last setting was correct you may want to jump ahead to the next box. | |
| | If you are still a little shaky on this type of setting, you will want to go to follow-through this box. | |
| | Our problem is 2 x 1.5 = ? | |
| 21 | We are to multiply _____(how many?) factors? | two |

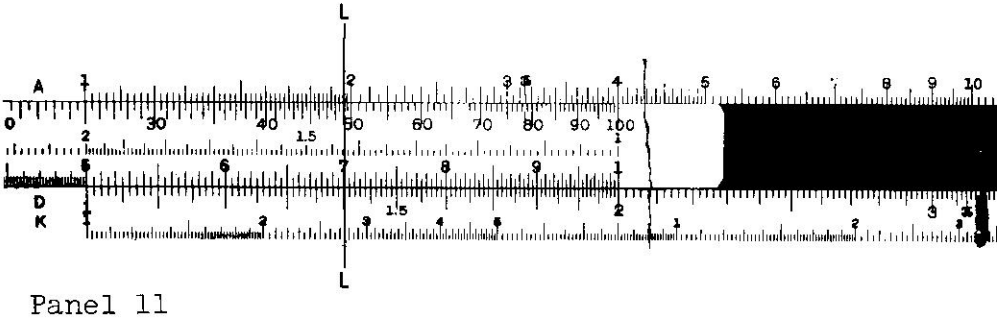
| | | |
|---|---|---|
| 22 | We have two factors, 2 x 1.5, to set on our slide rule. We set the first factor, 2, on our slide rule by moving the ___ index of the __-scale over this factor. (See Panel 9.) | left C-scale |
| 23 | With our first factor set under the left index of the C-scale, we move the _____to our second factor, (1.5), on the _____-scale, and then read the number of our answer on the _____-scale. In this case the answer is ____. (See hairline F, Panel 9.) | hairline C-scale D-scale 3.00 |
| 24 | Make the proper setting for the following problem and determine the answer from the setting of your own slide rule: 3 x 2.6 = ? | 7.80 - See Panel 10, hairline V. |
| | Follow these next directions carefully. | |
| | Our problem will be 2 x 7 = ? | |
| | Set your slide rule as you have before by putting the left index over the number 2. (Your slide position will be the same as in Panel 9.) | |
| 25 | Now, move your hairline along the C-scale until it is over the second factor, 7. With this setting, what reading do you get on the D-scale where you usually find your answer? | no reading |
| | It is not possible to get a reading since the D-scale does not extend far enough. | |
| 26 | Which index of the C-scale are you using in your present setting? | the left index |
| 27 | The C-scale has both a left index and a _____ index. | right |
| 28 | Now shift your slide so that the right index of the C-scale is over the number 2. Check the next answer. | See Panel 11. |
| | Our problem was 2 x 7 = ?, and we have our first factor (2) set under our index. Next we will move the hairline along the C-scale until it is over our second factor which is | |
| 29 | the number ___. | 7 |
| 30 | Then we will read the number of the answer below the hairline on the ____-scale, just as we did in the other problems. | D-scale |
| | Check the setting you've made on your slide rule with that of Panel 11, using hairline L. | |
| 31 | The number of the answer which we read off the D-scale is___. | 1.40 |
| | Since our problem was 2 x 7 = ?, we can see by inspection that while the number which we read off the D-scale is 1.40, this is not the correct answer. To get the correct answer | |
| 32 | from our number we will have to shift the _____. | decimal point |
| 33 | When we shift the decimal point of our slide rule number 1.40 to ____ we get the answer to our problem, 2 x 7 = ? | 14 |



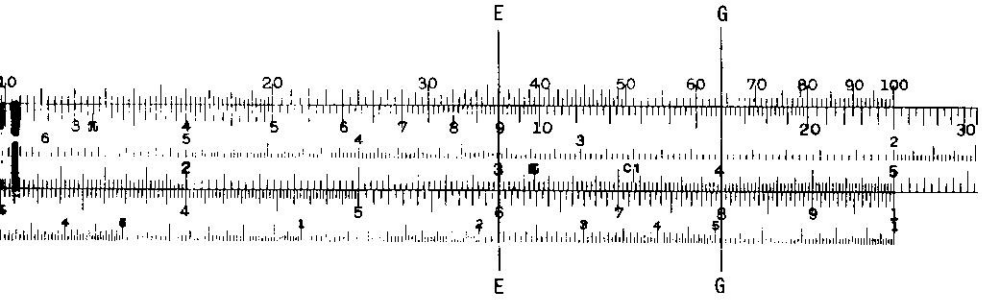

Panel 9



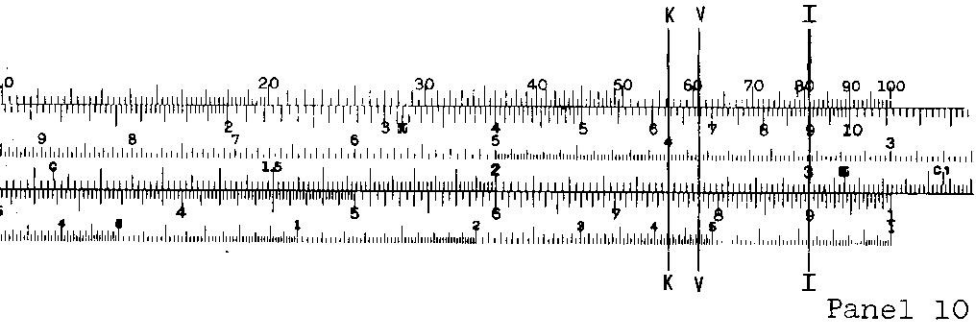

Panel 10



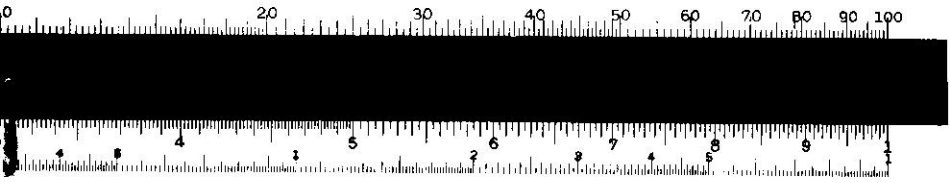

Panel 11




Panel 9




Panel 10



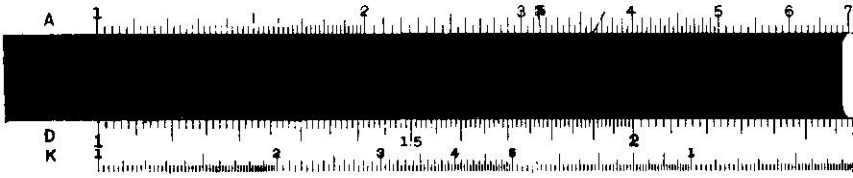
Panel 11

| | | |
|---|---|---|
| | Now to show you another little "twist", let's set our slide rule for the problem 7 x 2 = ? | |
| 34 | Set the factor 7 under the right index of the C-scale of your slide rule. Then check the answer. | Panel 12, page 37. |
| | Our problem is 7 x 2 = ? We have set the first factor, 7, on our slide rule. | |
| 35 | Now run the hairline along to the second factor, 2, along the ___-scale. | C-scale |
| | Your setting should be similar to that at hairline N in Panel 12. | |
| 36 | The number of the answer you read off the slide rule is ___. | 1.40 |
| | Since our problem was 7 x 2 = ?, we can see by inspection that the decimal point should come after the 4, giving us the correct answer 14. This is the same answer we arrived at in the last box!! | |
| 37 | The purpose of these last 3 items was to demonstrate that particular order of setting the factors of a multiplication problem on a slide rule _____(does, does not) affect the answer. | does not |
| | Set your slide rule to solve the following problem: | |
| 38 | 7 x 5.4 = ? | Panel 12, hairline R |
| | You'll notice that you haven't been asked to give any answers to these problems, but you have only been asked to give the number indicated by the hairline. The answer to a multiplication must have the proper decimal point. | |
| 39 | The number indicated by the hairline will be, as usual, in our form of a number between 1 and ____. | 10 |
| 40 | For instance, the number indicated by hairline R on the D-scale is ____. | 3.78 |
| | Since our problem was 7 x 5.4 = ? we can see that even though the number of the answer is correct, its decimal point is not correct. Just by inspection we can see that the answer should be 37.8. We know that the slide rule will give us the correct number of our answer, but we must | |
| 41 | decide on the correct location of the ___point in our answer. | decimal |
| | In all of these problems you would do well to make the settings needed on your own slide rule and give the answers from your own slide rule, if possible. | |
| 42 | In this box we will follow-through a complete problem including the proper placing of the ___point in our final answer. | decimal |
| | Let's do the problem 7 x 1.6 = ? | |
| 43 | In Panel 12, and on your own slide rule, you have already set the number____on the ____-scale by putting the right index directly over it. | 7.00 D-scale |
| 44 | Now, in doing the problem 7 x 1.6 = ?, we move the hairline along the ___-scale until we locate the number ____. | C-scale 1.6 (or, 1.60) |
| 45 | If you have done this on your own slide rule, your hairline ought to be in the same position as that indicated by letter ____ in Panel 12. | M |

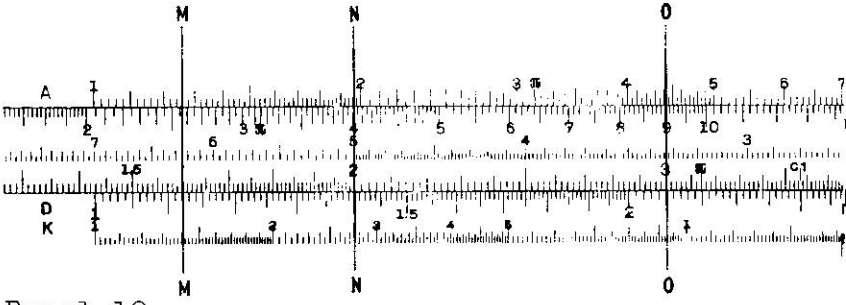
| | | |
|---|---|---|
| 46 | Then, under the hairline we can read the answer on the ____-scale. | D-scale |
| 47 | In this case, the number of the answer under the hairline on the D-scale is the number_____.<br>This is the number -- not the correct decimal answer. | 1.12 |
| | Since our problem was 7 x 1.6 = ?, we can see by inspection just where we ought to put the decimal point in our number for the correct answer. | |
| 48 | Select the correct answer:<br>a) .112<br>b) 1.12<br>c) 11.2<br>d) 112. | 11.2 |
| 49 | The slide rule will give us the digits in the answer, but we must supply the correct position of the ____ _____ to get the correct answer. | decimal point |

| | | |
|---|---|---|
| | Our next problem will deal with rounded-off numbers.<br>Suppose our problem was 7.0 x 50.99= ? | |
| 50 | We would first locate the number 7.0 on the ___-scale and and move the slide until the ___ _____ was directly over it. | D-scale<br>right index |
| | Our problem is 7.0 x 50.99 = ? We have located the 7.0 and now want to set our other factor, 50.99. | |
| 51 | This last number has ___(how many?) figures? | 4 |
| 52 | The number 50.99 has four figures, but we have found that we can usually set only ___figures on the slide rule. | 3 — |
| 53 | So, we will have to round-off 50.99 to three figures. This will give us the number_____ | 51.0 |
| 54 | In setting this number (51.0), we merely have to locate 5.10 on the C-scale with our hairline. Do this on your slide rule. Which hairline on Panel 12 shows this setting? | Q |
| 55 | We will read our answer on which scale? | D-scale |
| 56 | What is the number which we read on the D-scale with this setting of hairline Q? | 3.57 |
| | Going back to our original problem, 7.0 x 50.99, we must now place the decimal point in the correct position to get the correct answer. By inspection we see that this problem is approximately the same as 7 x 50, which is about 350. | |
| 57 | Therefore, using our slide rule number of 3.57 we would select the correct answer:<br>a) 0.357<br>b) 3.57<br>c) 35.7<br>d) 357<br>e) 3570 | 357 |
| | It is usually possible to easily determine the decimal point by inspection, as we have done here. | |

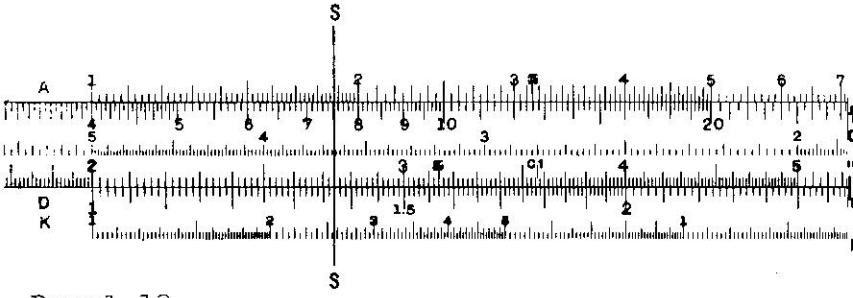
| | | |
|---|---|---|
| 58 | Set your slide rule for the following problem, and get your answer from your own slide rule.<br>5.00 x 2.74 = ? | 13.7<br>Panel 13, hairline S. |



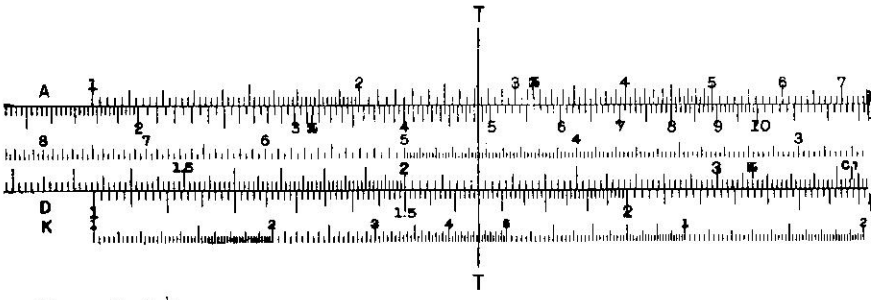

Panel 10



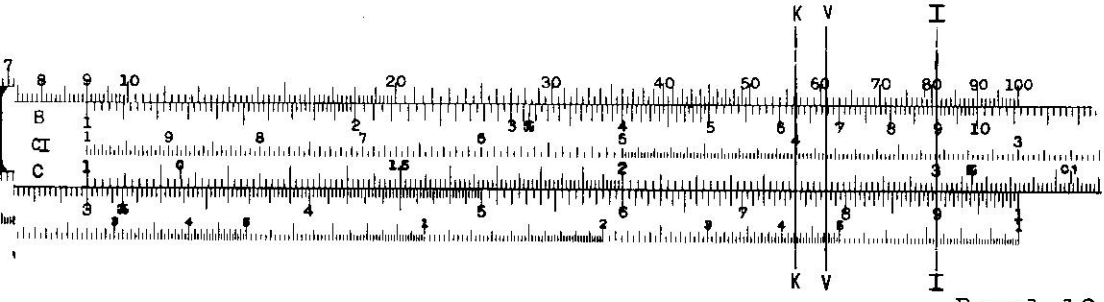

Panel 12



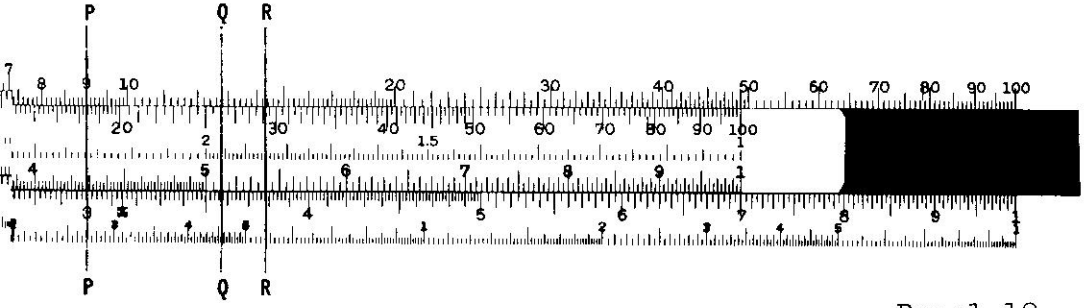

Panel 13



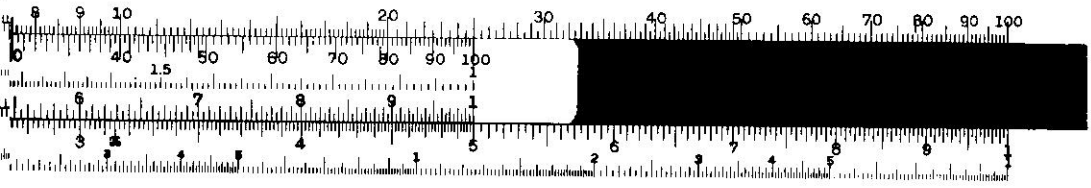

Panel 14



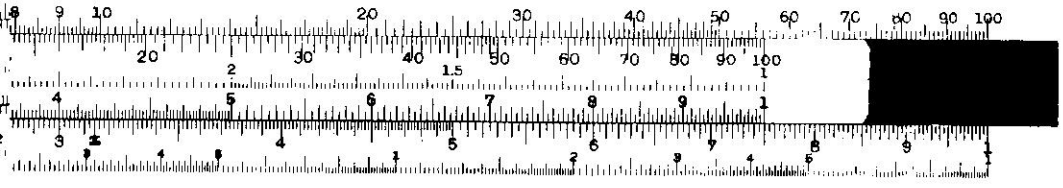

Panel 10




Panel 12



Panel 13



Panel 14

If your setting and your answer were correct you could go to the next box. If your setting was wrong, or you feel you need more practice, finish this box. If your setting was okay but you read your answer wrong, you may want to review the method used to read the slide rule scales covered in an earlier program. Look at Panel 13 and set your own slide rule the same way, with your hairline the same as S.

59 In the problem 5.00 x 2.74 = ?, the two factors are _____ and 2.74. — 5.00

60 The ___ _____ is set over the factor_____. — right index 5.00

61 The hairline S (and on your slide rule) is then moved over the other factor 2.74 on the ___-scale. — C-scale

62 The answer is then read below the hairline on the ___-scale. In this case the number is____. — D-scale 1.37

63 This number is not the answer, since the ____ _____ has not been properly placed, yet. — decimal point

64 Since our original problem was 5.0 x 2.74 = ?, we can see by inspection that the number ought to be a little larger than 10 (since 5 x 2 = 10). Since our number on the D-scale was 1.37, the answer (with the correct decimal point) will be ____. — 13.7

Set your slide rule to solve the following problem, and get your answer from your setting correct to three significant figures, and with the proper decimal point:

65 75 x 220 = ? — 16,500, Panel 14, hairline T.

If your setting and answer were correct you could go on to the next box.

If your setting was wrong, or you'd like more discussion on this part, finish this box.

If everything else was okay but your decimal point was misplaced, keep the setting on your slide rule and go on to Item No. 70.

66 In the problem 75 x 220 = ?, we would first want to change these two factors into the number form we're used to using. This means 75 is changed to 7.5 and 220 is changed to ____. — 2.20

67 We will locate 7.5 on the ___-scale and put the right ____over it. — D-scale index

68 Then we move the hairline along the ____-scale until we reach our second number, 2.20. — C-scale

69 The answer is then read on the ___-scale. — D-scale

70 The number on the D-scale under the hairline T (and on your slide rule) is _____ — 1.65

71 Our problem was 75 x 220 = ? By inspection we see that this is about the same as 100 x 200, which gives us a product of___. — 20,000

72 Since our number under the hairline on the D-scale was 1.65, and since the answer should be "about" 20,000, the correct answer (with the proper decimal point) would be _____. — 16,500

In setting the factors involved in a multiplication problem on our slide rule scales it is often necessary to round-off our numbers given in order that they may be properly set on the slide rule.

For instance, suppose a problem was given you as follows:

3001 x 2499 = ?

73 How many significant figures do we usually use with the slide rule? — 3

74 In this problem of 3001 x 2499 = ? each of our factors has four significant figures. Therefore, we will have to "round off" each of these factors until each has only ____ significant figures before we can set them on our slide rule. — 3

75 When we round off 3001 to a number we can set on the slide rule, we round it off to _____. — 3000

76 On the slide rule we set 3000 as the number_____. — 3.00

Set this number as 3.00 on your slide rule as the first factor in multiplying.

77 After making your setting of this single number as a first factor in multiplication, check the answer. — See Panel 10.

We have not yet made a hairline setting.

78 So, we have set the first factor of 3001 x 2499 = ? Now to set the second factor. When you round off 2499 to a number you can set on the slide rule you get _____. — 2500

79 On the slide rule we set 2500 as the number_____. — 2.50

80 Using your hairline, include the number 2.50 as the last part of your setting of 3001 x 2499 = ? — Panel 10, hairline K.

After making your setting, check the next answer.

81 The number of your answer will be read on the ____-scale. — D-scale

82 The number of your answer for 3001 x 2499 = ? is _____. — 7.50

83 Is this number 7.50 the correct answer for 3001 x 2499? — No!

84 The digits are all right, but the ___ _____ is not correctly placed. — decimal point

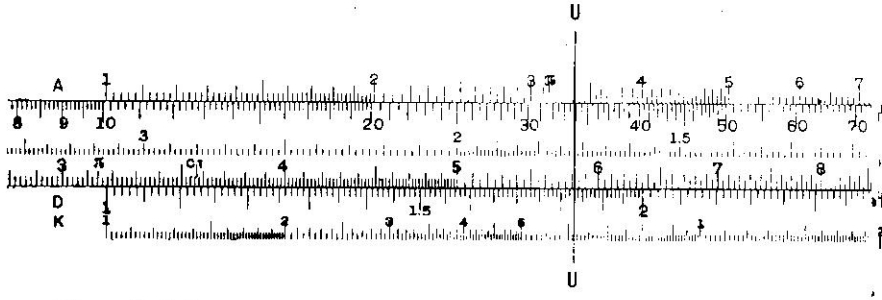
By inspection we can see that 3001 x 2499 is about the same as 3000 x 2000. This last product is 6,000,000, so our answer must be close to 6,000,000.

85 Which of the following numbers would you select as being correct for the problem, 3001 x 2499 = ?

a) 7.5
b) 7,5000
c) 75,000,000
d) 7,500,000
e) 750,000 — d) 7,500,000

86 This is not the exact answer, of course, since our slide rule will give us results which are correct to _____ significant figures. So our answer is closer to 7,500,000 than it is to 7,510,000 or 7,490,000. — 3

Usually our work will not require any closer accuracy than three significant figures.




Panel 15

Suppose your problem was 314.8 x 58.1 = ?

87 Set your slide rule for this problem and read-off your answer, with 3 significant figures including the proper placement of the decimal point before looking ahead at the answer.

18,300
See Panel 15.

If you handled the rounding off of the number 3.418, and the determination of the placement of the decimal point to your own satisfaction, you may want to go on to the next box.

If you want to go through a detailed discussion of this last problem, continue on with this box.

If you want a detailed coverage of only the placement of the decimal point in the answer, go to Item No. 91.

88 Our problem was 314.8 x 58.1 = ?. Since we can usually set only ___ figures on our slide rule, we will have to round-off the number 314.8 to ____.

3
315

So, we've changed our problem to 315 x 58.1 = ? We shall now set these numbers on our slide rule, putting the right index of the C-scale over the number 3.15 and moving our hairline along the C-scale to the number 5.81.

89 Then we shall read our answer on the ___-scale, as shown in Panel 15. The number of the answer, as read off the scale is _____.

D-scale

1.83

You might even read the last number as 1.832, but it is closer to 1.83 than it is to 1.84.

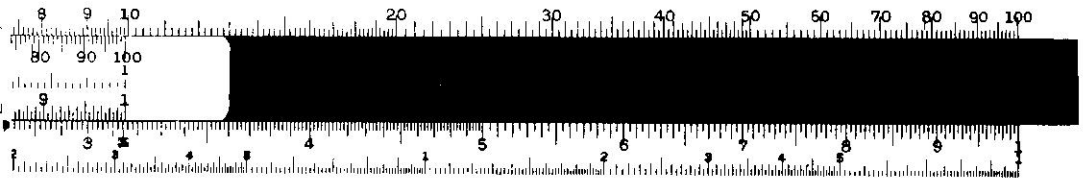
90 This is the number of our answer, as taken off the D-scale. We must now determine the proper placement of the ___ _____ to get the answer to our problem.

decimal point

Our original problem was 314.8 x 58.1 = ?
We could say, very roughly, that this is about the same as 300 x 60. 300 x 60 = 18,000, so our answer should be close to this value.

91 The number of our answer was 1.83. The value of our answer ought to be close to 18,000, so the answer to our problem will be _____.

18,300



## Panel 15

Skill in using the slide rule comes only from practice in using it. In the following problems your answers ought to agree exactly with the first two figures of the answers given by the program. There may be a difference in the third figure, since this third figure is often a matter of individual interpretation.

Make your settings, read off your answer, and properly fix the decimal point BEFORE going ahead to check your answer with the program.

If you are confused in making any of these settings, remember the setting you used for 2 x 3 = 6, and set your problem the same way.

| | | |
|---|---|---|
| 92 | Solve: 123 x 83 =<br>The answer would be 10,210 if you read it to four figures. | 10,200 |
| 93 | Solve: 338 x 2.08 = ? | 703 |
| 94 | Solve: 236 x 41.5 = ? | 9,790 |
| 95 | Solve: 0.027 x 1930 = ? | 52.1 |
| 96 | Solve: 64.2 x 118 = ? | 7,580 |
| 97 | Solve: 0.7352 x 52.65 = ? | 38.7 |
| 98 | Solve: 3677 x 5.081 = ? | 18,700 |

Panel 16

## SLIDE RULE DIVISION

You will find that the operation of the slide rule in dividing is even simpler than that for multiplying.

Suppose our problem was $\frac{6}{3} = ?$

To make this setting, move your hairline along the D-scale until it is directly over the number 6.00.

1 This is the number we are dividing _____ (into, by). into

Now, leaving the hairline where it is, directly over the 6 on the D-scale, move the slide until the number 3.00 on the C-scale is also directly under the hairline.

2 The number 3 is the number we are dividing _____ (into, by). by

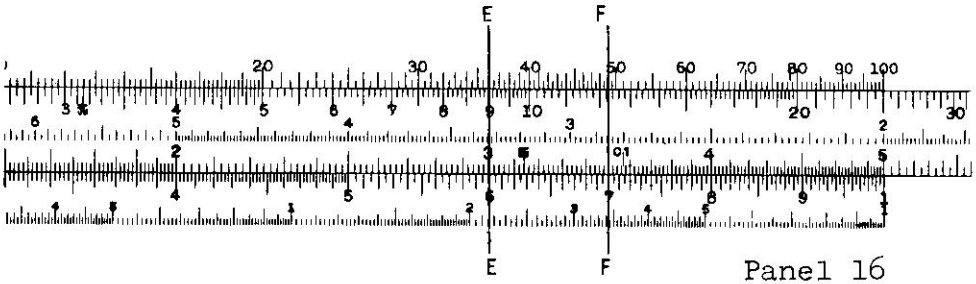
Now your setting on your slide rule should look just like Panel 16 with hairline E.

Can you see where we read the answer to our problem of $\frac{6}{3} = __?__$?

3 We read the answer on the _____-scale, under the left _____ of the C-scale. D-scale index

4 From your own slide rule, or Panel 16 (with hairline E), we read the answer, in this case, to be _____. 2

Notice that this setting that you have just made is exactly the same as that used for the problem $2 \times 3 = 6$. So, if you forget which number goes on the D-scale and which on the C-scale, all you have to do is make this fundamental setting, as we have in Panel 16, with hairline E, and you can tell what goes where.




Panel 16

| | | |
|---|---|---|
| 5 | For instance, in Panel 16, hairline E, we see that the number we are dividing <u>into</u> is always set on the _____-scale. | D-scale |
| 6 | The number that we are dividing <u>by</u> is set on the _____-scale directly over the first number. | C-scale |
| 7 | These two numbers are accurately lined up through the use of the _____. | hairline |
| 8 | The answer of a division problem on the slide rule is merely read off the _____-scale directly below the left (or right) _____ of the C-scale. | D-scale<br>index |

Now "break" your present setting on your slide rule by lining up the C and the D scale indexes.

Our next problem will be $\frac{7}{3.5}$ = ?

| | | |
|---|---|---|
| 9 | Our first move is to slide our hairline along the _____-scale, and locate the number 7, since we are dividing <u>into</u> this number. | D-scale |
| 10 | Now, with the hairline over 7 on the D-scale, slip your slide until the number 3.5 on the _____-scale is directly under the same hairline. 3.5 is the number we are dividing _____ (by, into). | C-scale<br>by |
| 11 | Now we look for our answer down on the _____-scale, under the _____ _____ of the C-scale. | D-scale<br>left index |
| 12 | The answer, in this problem, is _____. | 2 |

Panel 16, hairline F shows the setting.

Panels 17-20 after next page.

13 Set your slide rule for the following problem and read-off your answer:

$$\frac{52.5}{35} = ?$$

1.5

Panel 17 with hairline G shows the proper setting for the problem in the preceding box.

If you made this setting without any trouble, and got the correct answer you may want to go on to the next box.

If you want to go through more discussion of this setting, continue on in this box.

Our problem was $\frac{52.5}{35}$ = (Panel 17 with hairline G shows the setting.)

14 Our first step is to locate the number we are dividing _____ (into, by). into

15 Using the hairline, we locate the number we are dividing into on the _____-scale. D-scale

16 In this case, it is the number 52.5. In Plate 17 it is shown at the hairline with the letter _____. G

17 With the hairline set over the number we are dividing into on the D-scale, we slip the slide of the slide rule until the number we are dividing _____ (into, by) on the C-scale is directly under this same hairline. In this case, the number is 35. by

18 The answer to the problem is then read on the ____-scale under the _____ _____ of the C-scale. In this case the answer is _____. D-scale left index 1.5

19 Set your slide rule for the following problem, and get your answer:

$$\frac{42}{56} =$$

0.75

Panel 18 with hairline H shows the proper setting for the problem in the last box.

Look at your own setting, if correct, or at Panel 18, hairline H.

20 In this case, the answer was read under the _____ (left, right) index of the C-scale. right

21 Either index of the C-scale may be used to indicate the answer. However, the answer (quotient) of a division problem is always read on the _____-scale. D-scale

If your setting on the last problem was OK and you got the correct answer, you will want to go on to the next box.

If everything else is OK with your last setting, but you are puzzled by the decimal point, go to Item No. 27.

Panels 17-20 on next page.

If your setting was not correct, at first, or you would like to have a little more discussion and practice on the setting for division, we'll go through this setting in detail.

Our last problem was $\frac{42}{56}$ = ?

22 Our procedure is always the same. First we will set the hairline over the number we are dividing into (42) on the _____-scale. (Do this). — D-scale

23 Now our hairline is set over 42 on the D-scale. Now move the _____-scale until the number we are dividing by (56) is directly under this same hairline. — C-scale

24 While this was being done, the hairline _____ (was, was not) moved. — was not

After making its first setting, the hairline is not moved.

25 Now all we have to do is to read the answer on the _____-scale. — D-scale

26 The answer is indicated, in this case, by the _____ _____ of the C-scale. — right index

See Panel 18, hairline H, for proper setting.

27 The number of the answer on the D-scale for this problem is 7.50.

By inspection of the problem, $\frac{42}{56}$, we can see that the answer will be a little less than 1, or _____. — 0.75

28 Solve: $\frac{195}{137}$ = ? — 1.42 (Or, 1.423)

If you had this correct, go on to the next box.

If you did not get this answer, or if you want more practice, continue in this box.

Our last problem was $\frac{195}{137}$ = ?

The setting of this problem is shown in Panel 19, using hairline V.

29 Which was the first number you should have set the hairline over? — 195

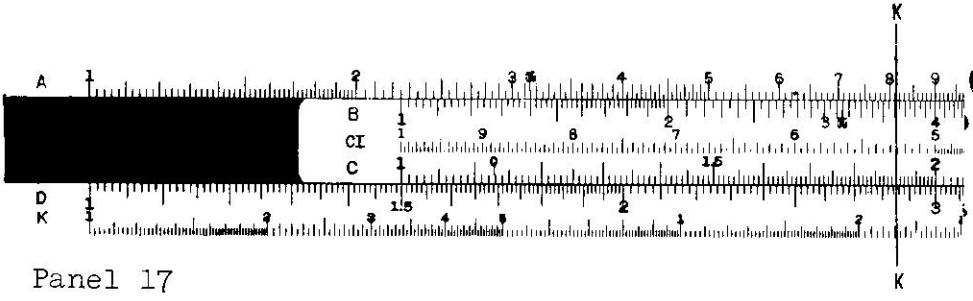
30 This number is "set" first on the _____-scale by moving the _____ over it. — D-scale; hairline

31 After the hairline is in this position it _____ (is, is not) moved again for this problem. — is not

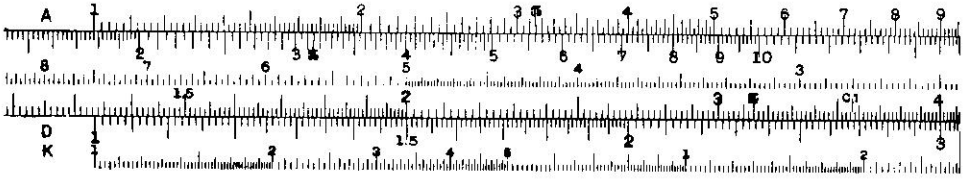
Our problem is $\frac{195}{137}$ and we have already set the number 195 on the D-scale.

32 Our next step is to slide the _____-scale along until the number _____ is under the hairline. — C-scale; 137

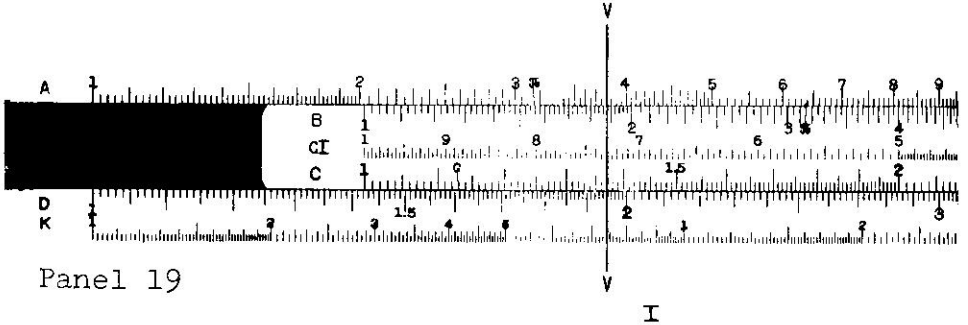
33 Our final step, then, is to read the answer on the _____-scale, under the _____ _____ of the _____-scale. — D-scale; left index; C-scale



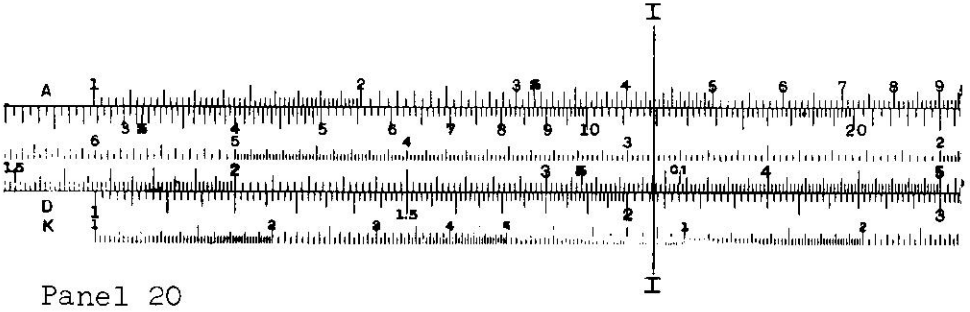

Panel 17



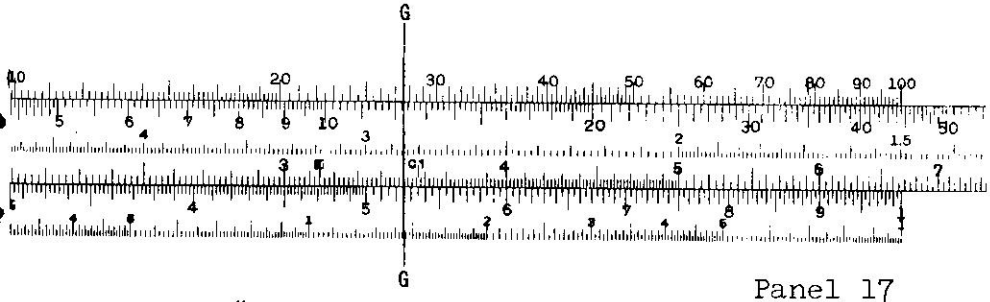

Panel 18



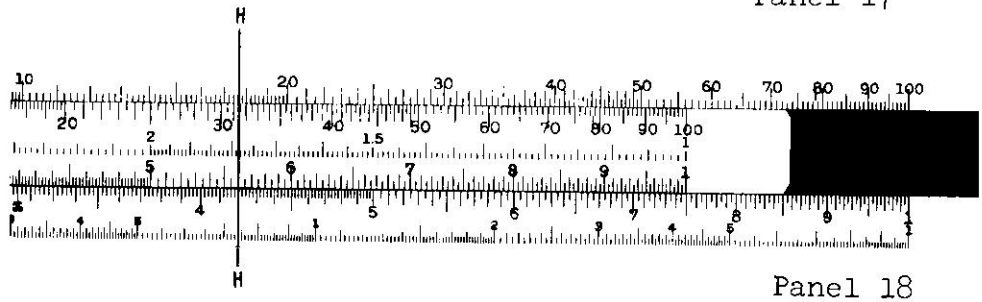

Panel 19



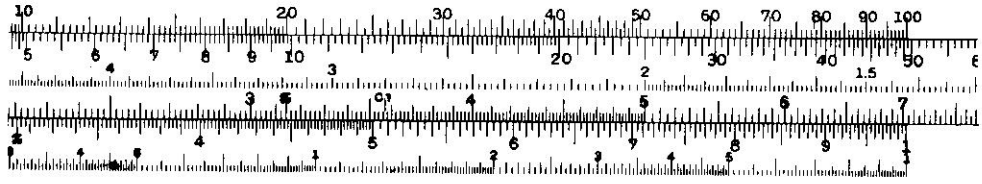

Panel 20



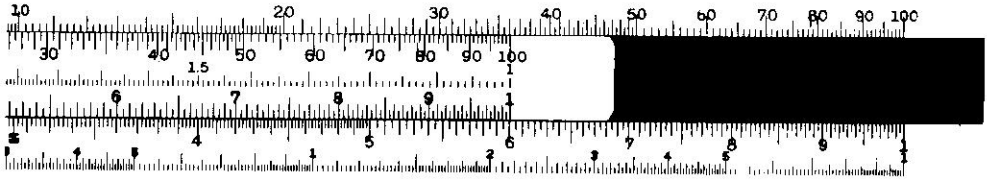

Panel 17




Panel 18



Panel 19



Panel 20

Panels 17-20 on preceding page.

34 Under the left index on your slide rule, and in Panel 19, you can read the number of the answer to three figures as being _____. 1.42

(Since the scale is a large one at this part of the slide rule, it is possible to read a fourth figure, if you want to, giving us a number of 1.423. The last figure is 3, since the number is about a third of the way from 1.420 to 1.430.)

35 Going back to our original problem, $\frac{195}{137}$ = ?, we can see that in this case the answer is more than 1 and less than 2, so the correct answer is _____. 1.42

36 On your own slide rule, solve the following problem:

$$\frac{28.51}{1.90} = ?$$ 15.0

If your answer was correct, if you rounded off your numbers OK, if you made your settings correctly, and had the decimal point of the answer in the right place, you may want to jump to the next box.

If you want to go over this problem in more detail, continue below.

37 Our problem was $\frac{28.51}{1.90}$. The first number we will want to set is _____. 28.51

38 This number has four figures, and we can usually only set _____ figures on the slide rule. 3

39 Therefore, we will round off 28.51 to the number _____. 28.5

40 This is the first number we will set, and we will set it on the _____-scale. D-scale

41 We set this number 28.5 on the D-scale by moving the _____ until it is directly over the number. hairline

42 Once the hairline is set, we _____ _____ move it again. do not

43 Then we take our second number in our problem, 1.90, and locate it on the _____-scale by moving the slide until it is directly under the _____ which we have been careful not to move. C-scale hairline

44 Now we have 28.5 on the D-scale and 1.90 on the C-scale both under the same hairline (as shown in Panel 17, hairline K), and we can now read the number of our answer directly on the _____-scale under the _____ _____ of the _____-scale. D-scale left index C-scale

45 In this case, the number of the answer on the D-scale under the left index is _____. 1.50

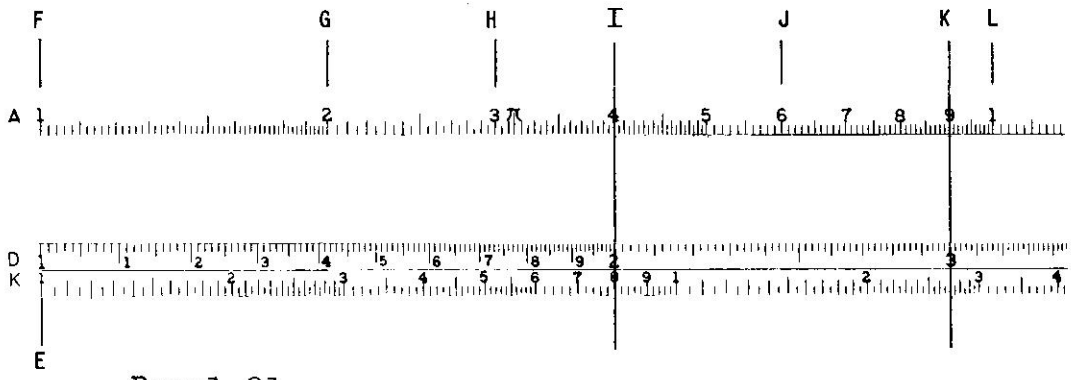
Our problem was $\frac{28.51}{1.90} = ?$ Since $\frac{28.51}{1.90}$ is approximately the same as $\frac{30}{2}$, we can see by inspection that the answer should actually be _____. 15.0

| | | |
|---|---|---|
| 46 | Solve: $\frac{20,698}{34.53}$ = ? | 600 |
| | (In this problem, be sure to write down your answer, including the correct decimal point, before exposing the answer given by this program.) | |
| | If you are satisfied with your handling of this last problem, go on to the next box. | |
| | If you'd like more drill on these divisions settings, finish out this box. | |
| | Our problem was $\frac{20,698}{34.53}$ = ? | |
| 47 | Since we can usually set only _____ figures on the slide rule, we will have to round-off these numbers. | 3 |
| 48 | The number 20,698 would be rounded-off to _____, and 34.53 would become _____. | 20,700<br>34.5 |
| | Thus our original problem of $\frac{20,698}{34.53}$ is changed to $\frac{20,700}{34.5}$ so that we can set it on our slide rule. | |
| 49 | In making the setting on our slide rule we shall first set the number _____ on the _____-scale by moving the _____ over it. | 20,700 (2.07)<br>D-scale<br>hairline |
| 50 | Then, being careful not to move the _____, we will set the number we are dividing by (34.5) on the C-scale by slipping the _____ until the number is under the hairline. | hairline<br>slide |
| 51 | Now we read the number of the answer on the ___-scale. | D-scale |
| | Our setting should be the same as shown in Panel 20, Hairline I. | |
| 52 | The number of the answer is directly under the _____ _____ of the ____-scale. | right index<br>C-scale |
| 53 | The number of the answer we read at this place on the D-scale is _____. | 6.00 |
| 54 | Now we have to decide on the proper placement of the _____ _____ in order to get our final answer. | decimal point |
| | Our original problem was $\frac{20,698}{34.53}$. This is about the same as $\frac{21,000}{30.00}$ and this quotient, we can see from inspection, is about 700. So our answer should be close to 700. | |
| 55 | Since the number of our answer is 6.00 (taken off the D-scale under the right index), which of the following would you select for the final answer to this problem?<br>a) 6.00<br>b) 60.0<br>c) 600<br>d) 6000 | 600 |

The problems which follow are presented with their answers, but with no discussion. In working these on your slide rule, your first two digits or figures of your answer ought to agree exactly with the answer given by the program. The third digit may not be the same as that given as the answer, since some interpretation and interpolation is needed to get this third digit. However, your third digit ought not to be more than a value of one away from the answer which is given.

For example, if the program answer is 91.7, then your answer might be 91.8, or 91.6, and still be OK. However, if your answer was 91.9 or 91.5 it would not be close enough to be correct.

| | | |
|---|---|---|
| 56 | Solve: $\frac{537}{278}$ .<br><br>Review Items 28 to 35 if this gives you any difficulty. | 1.93 (to three figures) |
| 57 | Solve: $\frac{273}{373}$ .<br><br>Review Items 28 to 35 if this was difficult for you. | 0.732 |
| 58 | Solve: $\frac{9.45}{3.98}$ . | 2.37 |
| 59 | Solve: $\frac{30.1}{745}$ . | 0.0404 |
| 60 | Solve: $\frac{0.00765}{0.0515}$ .<br><br>Items 36 to 46 cover a similar problem. | 0.149 |
| 61 | Solve: $\frac{222.2}{1.15}$ .<br><br>Items 36 to 45 cover a similar problem. | 193 |
| 62 | Solve: $\frac{2.885}{6023.5}$ .<br><br>If the decimal point bothers you, you might want to use powers of 10. | 0.000480 or $4.8 \times 10^{-4}$ |
| 63 | Solve: $\frac{8225}{900.5}$ . | 9.13 |
| 64 | Solve: $\frac{42,835}{6.896}$ .<br><br>If this gives you trouble you might want to review Items 47 to 55. | 6,200 |
| 65 | Solve: $\frac{24,565,234}{644.9}$ .<br><br>Review Items 47 to 55 if this was difficult for you. | 38,100 |
| 66 | Solve: $\frac{41.15}{8.55}$ .<br><br>Items 35 to 45 cover a similar problem. | 4.81 |

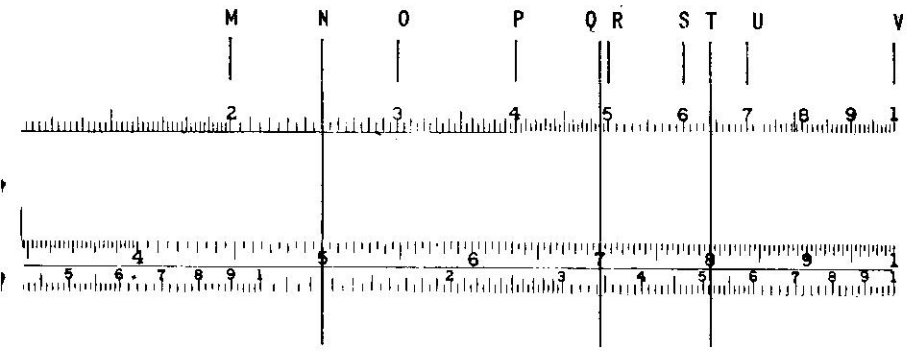



Panel 21

SLIDE RULE EXTRACTION OF SQUARE ROOTS

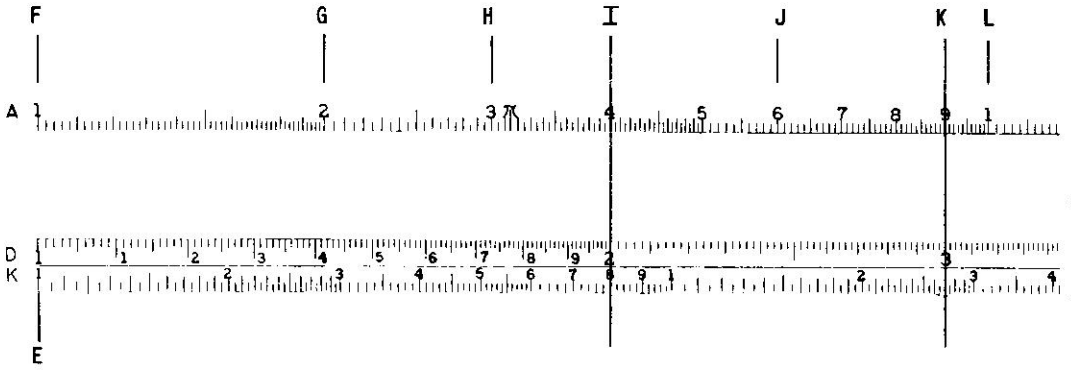
Our final operation with the slide rule will be the extraction of square roots. Strangely enough, this operation, which is one of the most difficult operations in arithmetic, is one of the simplest of all the slide rule operations.

| | | |
|---|---|---|
| | Look at Panel 21 at the top of this page. | |
| 1 | This is a slide rule which has had the _____ removed. | slide |
| 2 | In Panel 21, how many different scales are shown? | 3 |
| 3 | What letters are used to designate these three scales? | A, D, and K |
| 4 | We will not use the K-scale. In this program we will use only the ____ scale and the ____ scale. | A, D |
| 5 | What letter points to the left index of the D-scale? | E |
| 6 | What letter indicates the left index of the A-scale? | F |
| 7 | Suppose the letter F indicates the number 1. Then the letter G will indicate the number _____. | 2 |
| 8 | The letter J indicates the number ____. | 6 |
| 9 | The letter K indicates the number _____, and L points to the number _____. This is true, even though it is labeled as 1. | 9<br>10 |



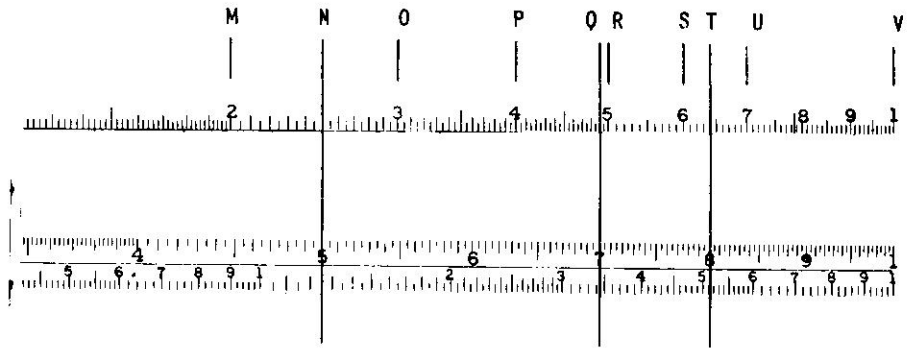

## Panel 21

| | | |
|---|---|---|
| 10 | The A-scale is really a double scale. The first part of this "double" scale runs from F to L, and the second part runs from L to the letter _____. | V |
| 11 | The left part of this A-scale, from F to L, is exactly the same as the right part of this scale which runs from _____ to _____. | L to V |
| 12 | The middle point of the doubled A-scale is marked with the letter _____. | L |
| 13 | The A-scale is used with the D-scale to get square roots. The numbers on the A-scale are located in the same way as numbers on the D-scale, but there are not so many division marks to guide us, since the A-scale is somewhat "compressed". The letter G, for instance, indicates the number 2. What number is indicated by the letter H? | 3 |
| 14 | What number is indicated by the letter J. | 6 |
| | Now, on your own slide rule, remove the slide from your rule. You'll need only the frame of your slide rule and the runner with its hairline. | |
| 15 | Carefully set your hairline on the number 4 of the A-scale, and then check the next answer. | Panel 21, hairline I. |
| 16 | What is the reading under this same hairline on the D-scale? (Check your own slide rule.) | 2 |
| | What you have done is to set the number 4 on the A-scale and read the number 2 on the D-scale. | |
| 17 | What is the square root of 4? | 2 |
| 18 | So, we can set a number on the A-scale and read its square root on the ____-scale. | D-scale |
| | Simple, isn't it? | Yes |




## Panel 21

| | | |
|---|---|---|
| 19 | Set the number 9 under your hairline on the A-scale. This setting is indicated by the hairline with the letter ____ on Panel 21. | K |
| 20 | With this setting you can read the number ____ on the D-scale. | 3 |
| 21 | The square root of 9 is ____. | 3 |
| 22 | See how well you have the rule for obtaining square roots in mind: To find the square root of a number, you set the hairline over the number on the ____-scale, and read the square root directly from the _____-scale under the hairline. | A-scale, D-scale |
| 23 | If the letter K indicates the number 9, then the next number, indicated by L, should be _____. Even though it's marked 1! | 10 |
| 24 | If L is 10, and M is 20, then O should be _____. | 30 |
| 25 | Following this same system, on the A-scale, P is ____ and R is ____. | 40, 50 |
| 26 | And, S is 60, and U is ____. | 70 |
| 27 | Now, between 60 and 70 on the A-scale (Letters S and U) put your hairline on the number 64. (Check the next answer.) | Panel 21, hairline T. |
| 28 | If we wanted to find the square root of 64, we would set 64 on the ____-scale under the hairline, and read its square root (also under the same hairline) on the _____-scale. | A-scale, D-scale |
| 29 | In the case of our present setting on your slide rule, the number you read on the D-scale as the square root of 64 is the number ____. | 8 |




## Panel 21

30 On the right hand part of the A-scale, set your hairline over the number 25 and find its square root. — 5

We all know the square root of 25 is 5, but you want to get this answer from your slide rule.

If your setting was correct and you read the answer of 5 from your slide rule, you may want to go to the next box.

If you're not too sure about your setting, finish this box.

31 Our problem was to extract the square root of 25. We did this by setting 25 on the A-scale. Set 25 on the A-scale under your hairline. — Panel 21, hairline N.

32 This setting is just half-way between 20 (indicated by the letter M) and the number ____ (indicated by the letter O). — 30

With this setting for 25 we can now read the square root of 25 directly under the same hairline on the

33 ____-scale. — D-scale

34 The reading under the hairline on the D-scale is ___. — 5

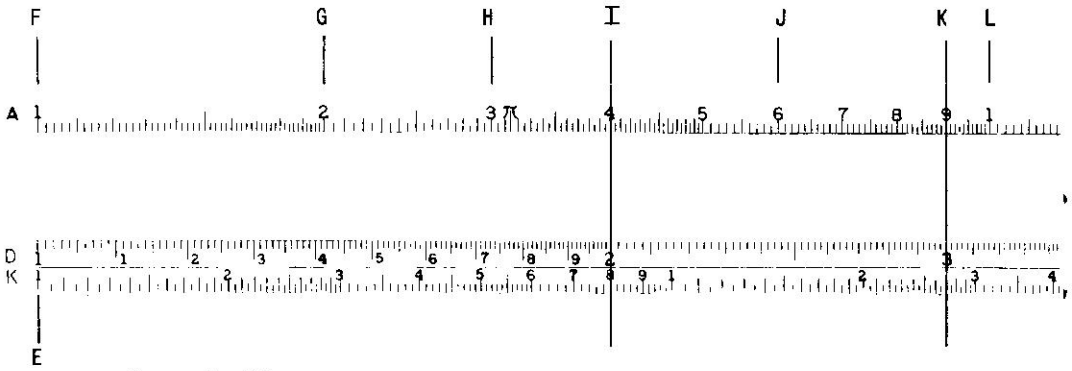
35 Make the proper setting on your slide rule to extract the square root of 49. What answer do you read from your slide rule? — 7

If you obtained this answer from your slide rule and had no trouble with your setting, go on to the next box.

If you had trouble with this setting on your slide rule, you'll want to go through the steps in this box.

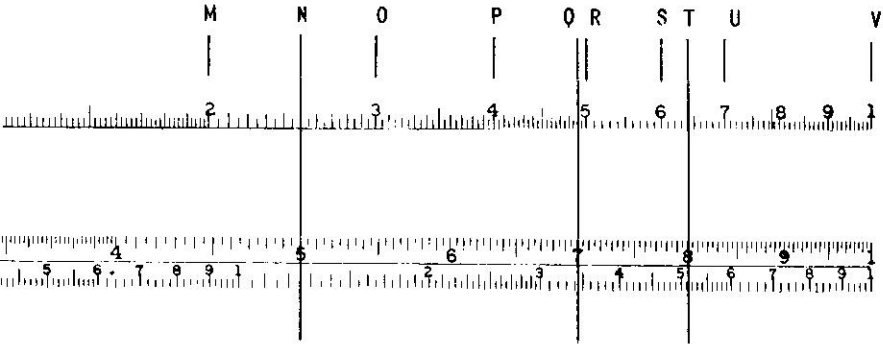
Our problem was to extract the square root of 49. Our first step is to set the hairline over 49 on

36 the ____-scale. — A-scale



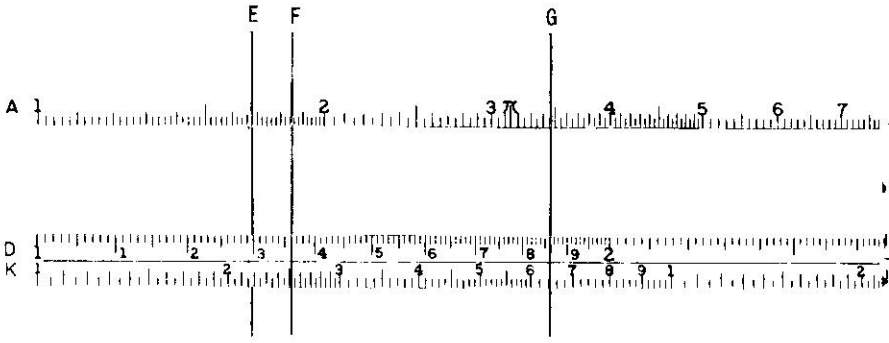

## Panel 21

| | | |
|---|---|---|
| 37 | Set your hairline over 49 on the A-scale. (Check the next answer.) | Panel 21, hairline Q. |
| 38 | Notice that P is 40 and R is 50 and Q is nine secondary divisions from 40 to give us the setting for the number ____. | 49 |
| 39 | Now, with our hairline set over 49 on the A-scale (hairline Q in panel 21) we can read the square root of 49 on the ____-scale as being 7. | D-scale |
| 40 | Now we'll try a tricky new setting. Set your hairline over the number 4 in the right hand part of the A-scale, or in the same position as indicated by the letter P in panel 21. With the hairline in this position, what reading do you get on the D-scale? | 6.31 |
| 41 | Is the square root of 4 equal to 6.31? | No! |
| 42 | Now move your hairline to the left section of the A-scale on the number 4 as indicated by hairline I. With the hairline in this position, what reading do you get on the D-scale? | 2 |
| 43 | Is the square root of 4 equal to 2? Thus, it is important to set your number in the correct section of the A-scale. | Yes! |
| 44 | Notice that we set the number 4 in the ____ section of the A-scale to get its square root. | left |
| 45 | How many digits are there in the number 4? | one |



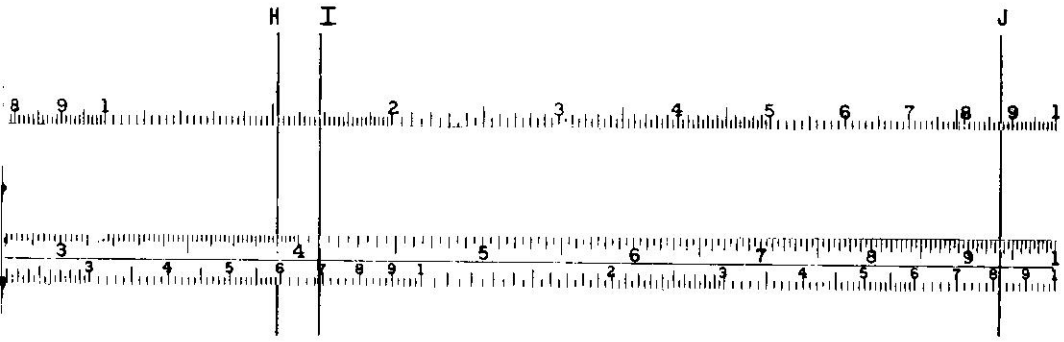

Panel 21

| | | |
|---|---|---|
| 46 | Notice that we set the number 25 (see hairline N) in the ____ section of the A-scale to get its square root. | right |
| 47 | How many digits does the number 25 have? | two |
| 48 | So, if a number has one digit, (for example, 4) we use the left section. If a number has two digits, (for example, 25) we use the right section. Suppose a number has three digits, (such as 225) which section of the A-scale would you guess that it should be set in? | left section |
| | Consider the following: | |
| | Number of Digits → Correct Section of the A-scale to use<br>1 → Left<br>2 → Right<br>3 → Left<br>4 → Right<br>5 → ____ | |
| 49 | How should the blank be filled in? | left |
| | Look at that chart again. | |
| 50 | If the number of digits in a number is odd, the number is set in the ____ section, and if the number of digits in a number is even, the number is set in the ____ section of the A-scale. | left, right |
| 51 | So, for an even number of digits, the ____ section is used; for an odd number of digits, the ____ section is used. | right, left |




## Panel 22

| | | |
|---|---|---|
| 52 | Suppose we are to find the square root of 346.<br>How many digits are there in 346? | 3 |
| 53 | Is this number of digits odd or even? | odd |
| 54 | Is this number set in the right section, or the left section of the A-scale? | left |
| 55 | Set your slide rule to determine the square root of 346, and read off your answer from your slide rule. | Panel 22, hairline G, 18.6 |
| 56 | In which section would you set the number 16,700,000 to extract its square root?<br>This is true because it has an even number of digits. | right section |
| 57 | On your slide rule determine the square root of 152,000.<br>If your answer was correct (with the correct decimal point), skip this box and the two following it.<br>If you got the number of the answer (3.90) but are uncertain as to how to get the correct decimal point for the answer, go to the next box.<br>If your answer was 123 (or a similar wrong answer), continue on in this box. | 390. |
| 58 | Our problem was to find the square root of 152,000. How many digits are there in this number? | 6 |
| 59 | Is this an odd number of digits, or an even number of digits? | even |
| 60 | Since the number of digits is even, this number (152,000) should be set in the ____ (left, right) section of the A-scale. | right |




Panel 22

If you did not get this last answer, or you are confused about this point of right and left sections of the A-scale, review items 44 to 52.

61 If you understand which section the number 152,000 is to be set in, go ahead and set it. — Panel 22, hairline H.

62 What is the number of the answer you get for the square root of 152,000? — 3.90

Our next task is to get the decimal point in the proper place. If you can already easily do this, skip this box. In extracting square roots, one of the things we must always do is to group the digits of our number into pairs, starting at the decimal point. For instance, if we "pair up" the digits in the number 234,456 we get the following pairs: 23 44 56

63 "Pair up" the digits (figures) in the number 125,098. — 12 50 98

In pairing up the digits in the number 379, we get 3 79, since we start our pairing from the decimal

64 _____. — point

65 Pair up the digits (figures) in 35,065. — 3 50 65

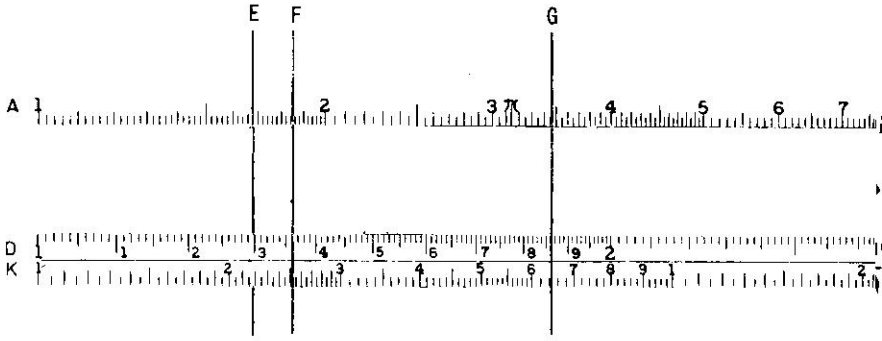
Starting at the decimal point, we can pair off the number 0.0345 as follows: 0. 03 45

66 How would you pair off the number 0.000876? — 0. 00 08 76

This pairing off makes it easy to determine the decimal point of our square root. For each pair of numbers in the number there will be one digit in the square root.

67 How many digits (or figures) will there be in the square root of 16,7000,000? — four

This is true since there are four pairs of digits in the original number.



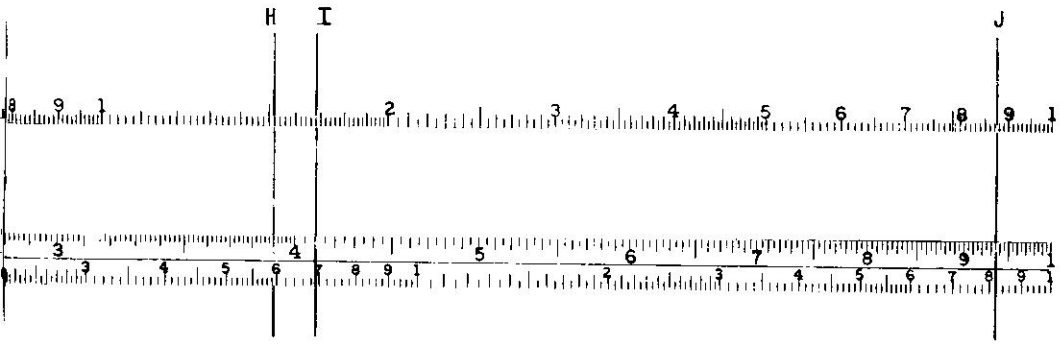

## Panel 22

| | | |
|---|---|---|
| 68 | How many figures will there be in the square root of 0.0016? | two |
| | Now we will get back to our original problem of getting the square root of 152,000. | |
| 69 | Pair off the number 152,000. | 15 20 00 |
| 70 | How many pairs does it have? | 3 pairs |
| 71 | How many digits will it have in its square root? | 3 |
| | Back at item 62 we determined that the number of the answer of this square root problem is 3.90. | |
| 72 | Now, knowing that the square root has three numbers in it to the left of the decimal point, what is the square root? | 390 |

If your number for which you wish to extract the square root is less than one (0.00234, for instance) you can determine which section of the A-scale in which to set it by merely counting the number of zeros to the right of the decimal point.

| | | |
|---|---|---|
| 73 | In the number 0.00234, how many zeros are there to the right of the decimal point? | two |
| 74 | Is this number of zeros odd or even? | even |
| | If this number of zeros is even, the number is set on the right section, and if it is odd, it is set | |
| 75 | on the ____ section. | left |

| | | |
|---|---|---|
| 76 | In which section of the A-scale would you set the number 0.00234 to get its square root? | right section |
| | Did you count to see that 0.00234 has an even number of zeros to the right of the decimal point? | |




## Panel 22

77 To extract the square root of 0.000206, you would set it in the ____ (left, right) section of the ____-scale.

left
A-scale

Did you note that 0.000206 has three zeros to the right of the decimal point ?

78 The simple rule to remember is that if a number less than one has an odd number of zeros to the right of the decimal point, it is set on the ____ section of the A-scale.

left

If the number of zeros to the ____ of the decimal point is even, the number itself is set in the ____ section of the A-scale.

right

right

79 In which section of the A-scale would 0.0000101 be set?

right section

This is true because it has an even number of zeros after the decimal point.

80 In which section of the A-scale would you guess that 0.16 should set?

right section

81 Will the number 0.008750 be set in the right section or the left section of the A-scale?

right section

82 Make the proper setting for extracting the square root of 0.008750 on your slide rule.

Panel 22, hairline J.

83 The number of the answer which is read off the D-scale is _____.

9.35

84 We are extracting the square root of 0.008750, and when we pair off this number we get .00 87 50. Since this number contains ____ (how many) pairs, and

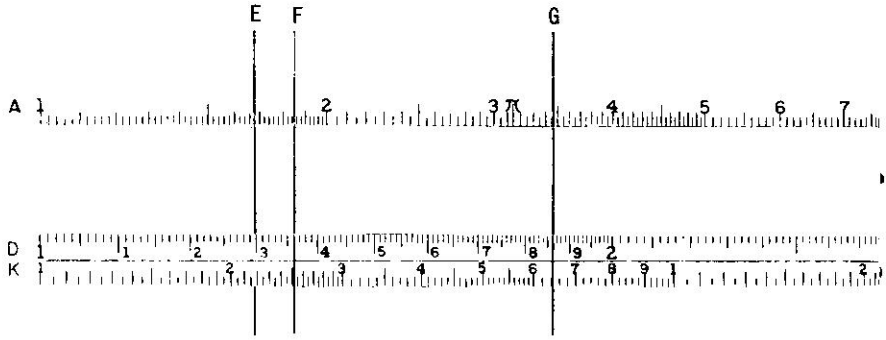
3

since each pair gives us one digit or figure in the square root answer, we will have at least ____ digits in our answer. The number of our answer is 9.35, so the correct square root would be 0.0_ _ _.

3

0.0935

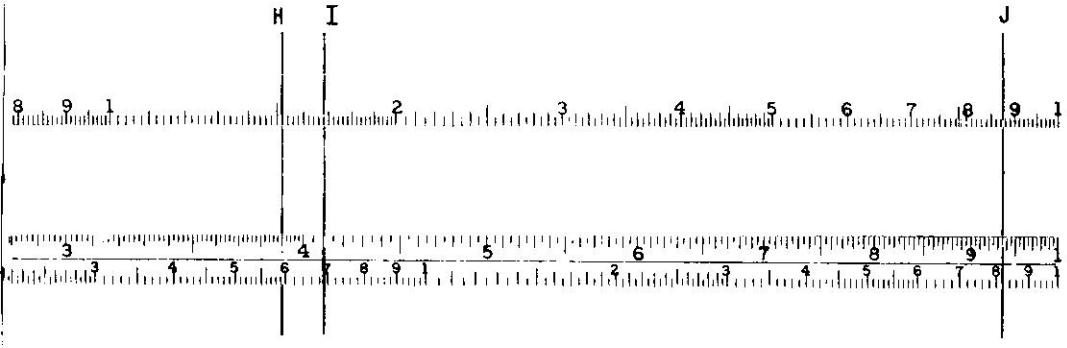
The zero after the decimal point of our last answer is there because our first pair was a double zero pair.




## Panel 22

| | | |
|---|---|---|
| 85 | Extract the square of 18,500.<br><br>If your answer was correct, go to the following box.<br><br>If your number was correct, but the decimal point was off, go to Item 89.<br><br>If your number was incorrect, finish this box.<br><br>The number we were to take the square root of was 18,500. | 136 |
| 86 | It has an ____ (even, odd) number of digits, and should be set in the ____ (right, left) section of the ____-scale. | odd<br>left<br>A-scale |
| 87 | Make the proper setting on your own slide rule. | Panel 22,<br>hairline F. |
| 88 | The number of the answer is read from the ____-scale as being _____. | D-scale<br>1.36 |
| 89 | In the number 18,500 we could point off ____ (how many) pairs? | 1 85 00,<br>3 pairs |
| 90 | There were three pairs, so there will be ____ digits in the square root. | three |
| 91 | So, our correct answer (taken from the number of the answer, 1.36) will be ____. | 136 |

| | | |
|---|---|---|
| 92 | Extract the square root of 0.0000168.<br><br>If your answer was correct, go to Item 104.<br><br>If the number of your answer was correct, but you are not sure about the placement of the decimal point, go to Item 99.<br><br>If your answer was not correct, go to Item 93. | 0.0041 |




Panel 22

| | | |
|---|---|---|
| | We are to extract the square root of 0.0000168. | |
| 93 | How many zeros are there to the right of the decimal point? | four |
| 94 | Is this (answer) odd or even? | even |
| 95 | In which section of the A-scale should the number 0.0000168 be set?<br>If this is not clear to you, re-do Items 73 to 81. | right section |
| 96 | Make the setting on your slide rule to get the square root of 0.0000168. | Check panel 22. |
| 97 | Which hairline shows the proper setting for 0.0000168?<br>The setting of E is wrong, since it is in the left section. | I |
| 98 | With the proper setting for 0.0000168, what number do you read for its square root?<br>Now we need to properly place the decimal point. | 4.10 (on the D-scale) |
| 99 | Take the number 0.0000168 and pair it off.<br>That last zero is merely added to pair off the 8. | 0. 00 00 16 80 |
| 100 | How many pairs are there? | 4 |
| 101 | How many places will the answer have? | 4 |
| 102 | Since our first two pairs are zeros (.00 00 16 80), our first two places will also be ____. | zeros |
| 103 | Since the number we read off the D-scale is 4.1, the answer with the correct decimal point will be _____.<br>If this last answer is not clear to you, go back to Items 63 to 71 for a review of decimal point placement. | .0041 |

In the following exercises, make the proper settings on your slide rule, write down your answer, place the decimal point in its proper place BEFORE you check the answer in the program. This will give you your best practice. In case you have trouble with any of these problems, reference is made to the part of this program which you might want to review.

| | | |
|---|---|---|
| 104 | Extract the square root of 154.<br>A similar problem starts with Item 52. | 12.4 |
| 105 | $\sqrt{16,400} = ?$<br>A similar problem starts with Item 85. | 128 |
| 106 | $\sqrt{60.8} = ?$<br>A similar problem starts with Item 35. | 7.8 |
| 107 | $\sqrt{0.00002850} = ?$<br>A similar problem starts with Item 92. | 0.00534 |
| 108 | $\sqrt{0.064} = ?$ | 0.253 |
| 109 | $\sqrt{181,000} = ?$<br>A similar problem starts with Item 57. | 425 |